SCIENTIFIC AMERICAN

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RECENT IMPROVEMENTS IN THE PNEUMATIC DYNAMITE GUN.

Since the early experiments of Mr. M. D. Mefford, on the pneumatic dynamite gun, and the subsequent experiments of Lieut. E. L. Zalinski and others, we have from time to time published the various steps in the progress of the gun toward completion. We have also described the interesting experiments which have been made with the different guns.

The latest improvements, which we now illustrate, have been invented and put in practice by Captain John Rapieff, of the Russian artillery, who is at present residing in this country, and filling the important post of chief engineer of the Pneumatic Dynamite Gun Company, of this city. The larger view in our front page engraving shows the gun in perspective, together with the loading apparatus, while the smaller view is a side elevation which gives a good idea of the proportions of the gun and its mountings. The inside views are side and end elevations partly in section, showing the firing compressed air reservoirs, and loading carriage, and their connection with the gun. The principal points of improvement are the balancing of the barrel on hollow trunnions, and mounting it in a carriage which can be turned through an entire revolution, the application of motors for elevating and training the gun, and last, and most important, the firing mechanism, by means of which great accuracy in firing is secured, and all errors arising from personal equation are eliminated.

The gun, which is necessarily smooth bore, is made of cast iron in several sections, provided with flanges which are bolted together, forming a tube having a length of fifty feet and an internal diameter of fifteen inches. The joints are all provided with a new and very efficient system of packing, which automatically tightens with the increase of pressure. The trunnions, which are hollow, communicate with an annular air space surrounding the barrel between them and the breech. The trunnions turn in boxes which support the barrel and at the same time serve to convey air to the trunnions in whatever position they may take. These boxes communicate by means of a swing joint with a cross pipe connected with the firing reservoirs located on opposite sides of the gun. The trunnion joints, as well as the swing joint, are provided with packed bearing surfaces, which may be removed for inspection or repacking without disturbing other portions of the gun.

A bronze sector attached to the under side of the gun, within the carriage, and concentric with the trunnions, is engaged by a worm arranged to be operated by an electric or water motor. The fixed base of the carriage is provided with a circular rack engaged by a pinion, also driven by an electric or water motor.

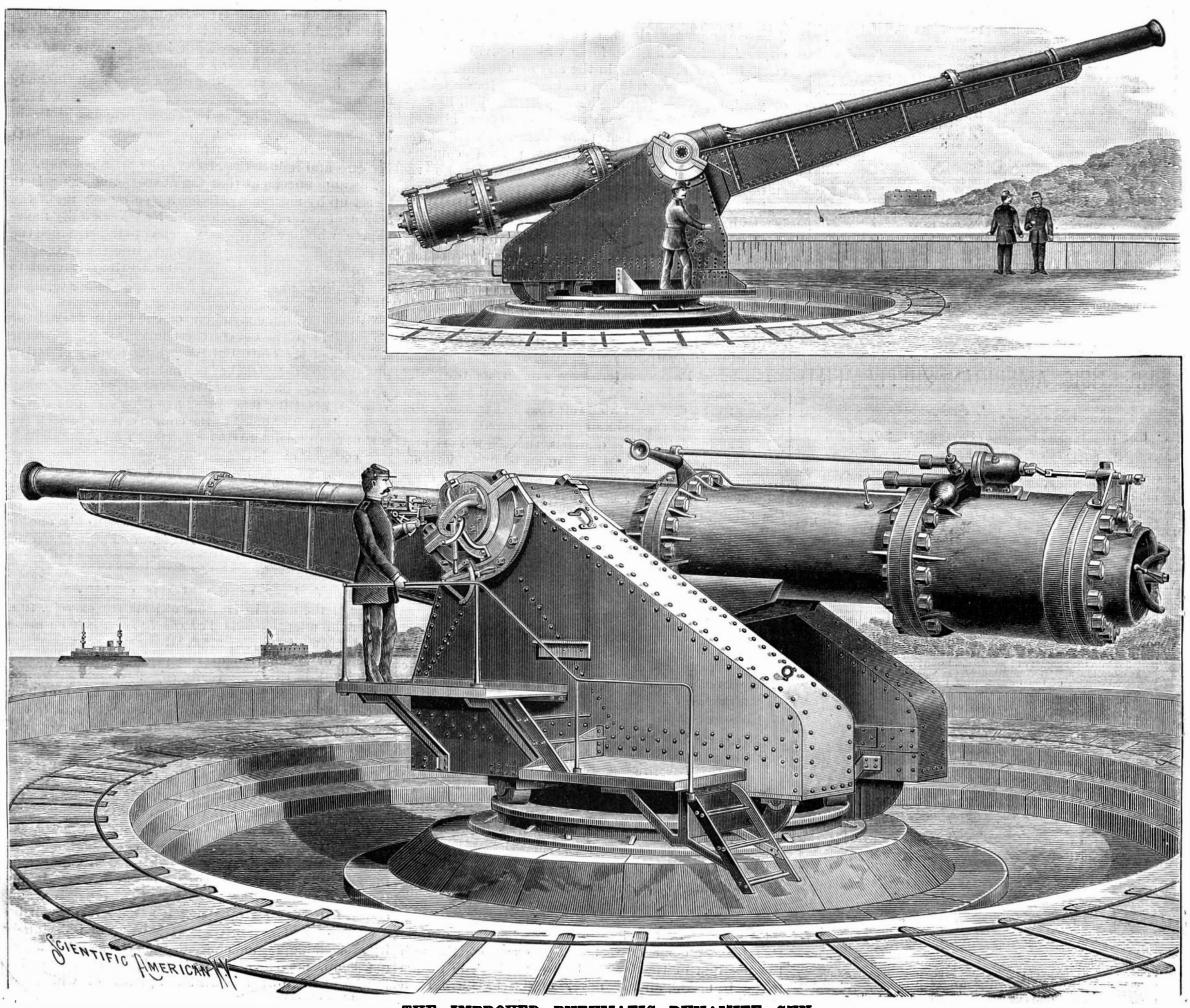
Besides these means of elevating and training the gun, the shafts are prolonged through the walls of the carriage to receive cranks for maneuvering the gun by hand power.

The gun is provided with a quick-closing breech piece, which packs itself automatically as soon as the air pressure is exerted upon it. The main firing valve is operated by air pressure controlled by an auxiliary valve, seen in the engraving, at the top of the breech of the gun, and this valve in turn is controlled by another located at the trunnion, operated by the gunner, who occupies the platform at the left side of the carriage. By a novel arrangement of pneumatically operated pistons and valves, the operation of opening the main firing valve proceeds automatically.

After the firing lever has been moved, the gunner has no control whatever over the speed of the movement of the main valve, the entire operation proceeding with mathematical accuracy. This is a feature which entitles Captain Rapieff to a great deal of credit, as it secures great accuracy in firing, and insures perfect uniformity in the action of the gun.

The projectiles are much the same as those heretofore described in our pages. Around the gun is a circular track upon which runs a carriage, this carriage serving to transfer the small loading trough on which the projectile has been conveyed from the magazine to the gun, irrespective of its position.

(*Continued on page* 182.)



THE IMPROVED PNEUMATIC DYNAMITE GUN.

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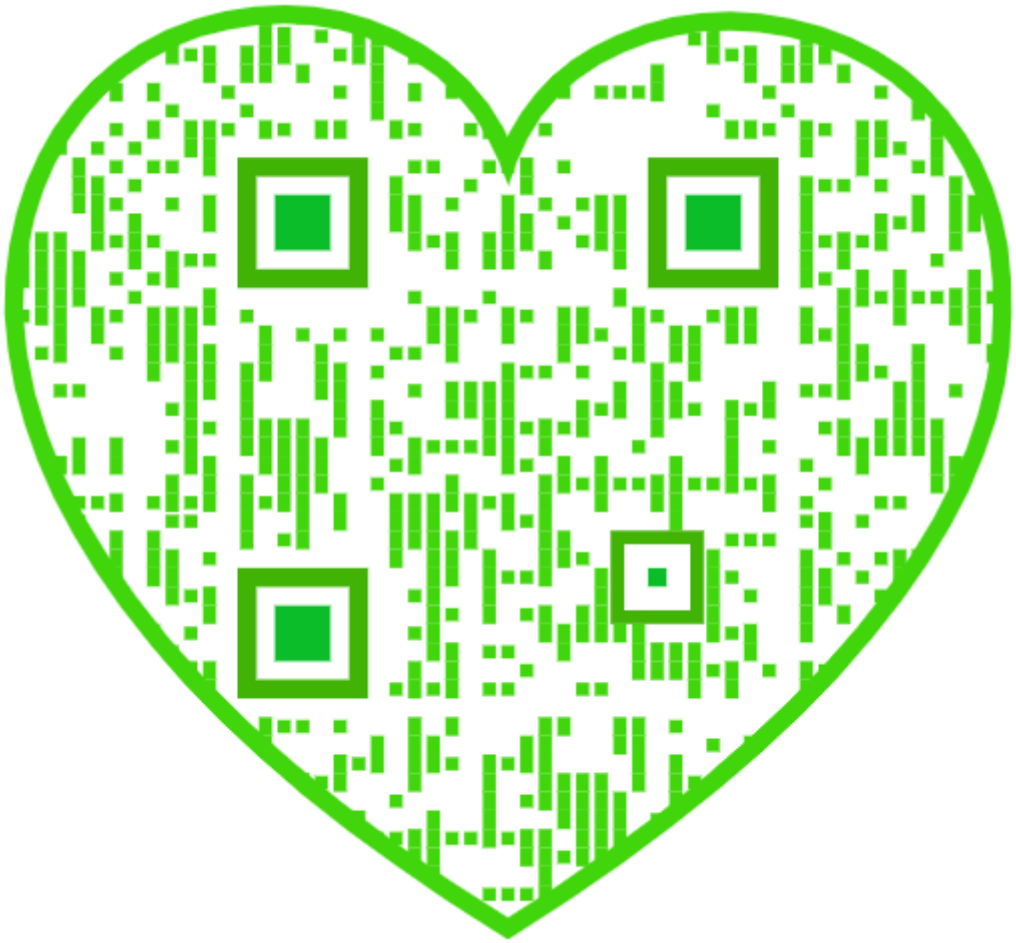

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THE SMOKE NUISANCE.

The Board of Health of Chicago is now prosecuting a vigorous war upon the authors of what is known as the smoke nuisance. Soft coal has of late years been so generally substituted for hard by manufacturers, by railroad companies, and by the owners of steam craft on the lake, that Chicago has become a very smoky city. Many buildings, especially those constructed of light-colored material, have been blackened and rendered very offensive to the eye. The soot finds its way into private dwellings, discoloring draperies and walls, while the garments of the people are quickly soiled when they go upon the streets, especially in the business portions of the city. Formerly hard coal was generally used in Chicago, and the clouds of black smoke which now hang like a pall over the city were unknown. But as new mines of soft coal have been opened and railroads have been extended the article has been cheapened, and those who consume large quantities of fuel have adopted it without regard to the effect its use would have upon the appearance of the city. A law was enacted which required all those who burned soft coal to use a smoke consumer, of which, it is said, there are at least thirty different kinds patented and unpatented. This law, up to March 30 last, was virtually a dead letter. Chicago having been selected as the site for the world's fair, the authorities of the city have been prompted to take steps toward the cleansing of the city, and one of the movements in this direction is the abatement of the smoke nuisance. Suits have been commenced against a large number of concerns and individuals. Some of these have paid their fines, others have agreed to go back to the use of hard coal, while still others have put in smoke consumers.

It is claimed that the smoke from soft coal would not be nearly so objectionable as it is were it not for the fact that the fuel is used in a wasteful manner. Firemen are accustomed to shovel more coal than is necessary into the furnace, and as a consequence large quantities of smoke goes into the atmosphere, which thus becomes charged with unburned carbon.

Cincinnati is so situated that soft coal is brought to her doors in large quantities and at very low rates. As a consequence she has also become a very smoky city. An ordinance is in force which provides "that every furnace employed in the city of Cincinnati, and every furnace upon railroad engines used for switching or yard purposes within the city limits, shall be constructed, or, if already constructed, shall be so altered, and shall have attached thereto efficient smoke preventives, as to produce the most perfect combustion of fuel or material from which smoke results, and so as to prevent the production and emission of all smoke therefrom, so far as the same is possible." This ordinance is not enforced. The city clerk of Cincinnati in a communication to the writer says: "There are so many manufacturers and others in the city whose business would be crippled were this ordinance enforced, that the inspectors (provided for in the ordinance) confine their work largely to fire escapes."

Cleveland is another city where the smoke nuisance prevails to an overpowering degree.

Pittsburg, Pa., was formerly known as the chief among smoky cities; but with the adaptation of natural gas to the uses for which soft coal was formerly employed, much of the smoke has disappeared.

It is claimed in some quarters that New York and adjacent cities are in serious danger of becoming victims of the smoke nuisance. The consumption of bituminous coal in this city and vicinity has increased, and the atmosphere is not as clear as it was a few years ago.

A leading coal dealer stated that a remedy would probably be found in the gradual adaptation of gas to all manufacturing and heating purposes. This movement had already commenced, and manufactured gas was being used to run engines, for cooking, etc.

In the meantime it would seem to be the part of wisdom for all municipal authorities to insist upon the use of such appliances as will prevent the escape of the smoke from soft coal, especially as experience has shown that this can be done. Chief Inspector Young, of Chicago, claims that between March 30 and September 1, 825 chimneys have been made to stop smoking.

Every railroad which enters the city excepting one has put smoke consumers on their locomotives, and the towing companies have adopted the same course with their steam craft. Preventive measures can be more easily enforced in localities where the smoke nuisance has not become so aggravated as in Chicago. This fact should be borne in mind by the authorities of New York and other cities where complaints are being made.

CONGRESS ought to issue a sufficient amount of fractional paper currency to facilitate exchange through the medium of the United States mail. The people found it useful, and it never ought to have been abolished.

Excursion of Scientists to Western Caverns.

During the Indianapolis meeting of the American Association for the Advancement of Science, an illustrated lecture was given on the great caverns of the Ohio valley, by Rev. H. C. Hovey, D.D., of Bridgeport, Conn., who has in a similar manner favored several annual meetings of this association. On this occasion the lecture was complimentary to the citizens, and was given at the request of the local committee, and was attended by a crowded and delighted audience. One result was the organizing of a large party of scientific excursionists to see the subterranean wonders so vividly described. At New Albany they were met by a delegation of citizens, who drove them for an afternoon amid the Knobs that environ that city. The troglodytes were piloted by Mr. Ben Hains through the mazes of Marengo and Wyandotte, and by Dr. Hovey himself through those of the famous Mammoth Cave. In this connection the fact may be noted that 11,000 copies of Hovey's guide book have been sold, and the author has a new edition in preparation for the coming season. Considerable improvements have also been made in the management of the cavern, under the able direction of Mr. H. C. Ganter, by which the most remote regions of the great cave are now accessible regardless of the occasional floods to which the subterranean rivers are liable. Those who have distressing recollections of the rough ride by stage coach from Glasgow Junction to the cave will be glad to know that the trip is now made by railroad to the park at the entrance, but without disturbing the natural wildness of the surroundings.

A Revolution in Printing.

The successful introduction of typesetting machines into a number of newspaper offices in the United States has greatly stimulated their competitors, and early in the autumn the New York *Sun*, *Times*, *World*, and other papers will commence their use. It is also said that the *Herald* will employ them. Probably one half of the one thousand compositors engaged upon the morning dailies will be dropped.

It is now announced that Theodore L. De Vinne, the printer of the *Century* magazine, has completed arrangements to have his typesetting done by machinery. Upon reliable authority it is stated that a syndicate of book publishers in New York have likewise made arrangements to put fifty or a hundred typesetting machines into a co-operative office, where all the body matter of cheap publications turned out in New York will be set up. This arrangement, which will be in working order upon the first of next January, is likely to increase the annual output of novels by one hundred per cent and reduce the already low price one-half.

The announcement that the *Century* magazine is to be set up by machinery, following so closely upon the action of several publishers of New York daily newspapers, who have made arrangements to introduce the Rogers and Mergenthaler machines into their composing rooms this fall, will be of momentous interest to the printers. A member of New York Typographical Union No. 6 says:

"Of course, some members of the Union are a little skeptical as to the benefit these machines will be to the followers of the craft, but the whole history of labor-saving machinery teaches us that nothing has yet been invented that has lessened the need of good workmen. When typesetting machines have been introduced into every newspaper office in the country, it will lessen the cost of composition to such an extent that papers which now contain eight pages will have twelve, and four-page papers will be increased to eight. The introduction of the machines will be a good thing for first-class men, but it may injure those who make a practice of tramping all over the country, working only one or two nights at a time."—*National Publisher and Printer.*

A Peep at the Secrets of Life.

One of the most interesting objects for examination under the microscope is *Valisneria spiralis* (the grass which grows in aquariums), when prepared to show cyclosis or circulation of the protoplasm. Professor Lockwood, in the *Microscope*, says:

"I think that, to the amateur at least, a hint how to observe the circulation of this favorite plant to the best advantage must be acceptable. I have never seen it better displayed than when under the excellent manipulation of Mr. F. W. Devoe, of the New York Microscopical Society.

"Having selected a bit of leaf, not too mature, he shaves off one side with a sharp knife, although a razor is better. It is then put on a slide, the shaven side up. A drop or two of clean water and a cover glass of medium thickness, with good illumination, follows, Mr. Devoe using a prism illuminator. Begin the examination with a six-tenths inch objective, and continue up to a sixth or a tenth. The result will be a vision of startling clearness. The vivid individuality of each bioplasmic molecule, and the mystic, almost a solemn, movement of this pellucid stream of infinities of life, form a sensational picture of which the beholder never tires."

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The Pig Iron Industry.

The Census Office has issued a bulletin showing the production of pig iron in the United States for the year ending June 30, 1890. Great credit is due Dr. William M. Sweet, of Philadelphia, for this magnificent achievement in statistical work. The following points condensed by the *Iron Trade Review* from the report will no doubt be read with interest:

The production of pig iron for the census year of 1890 was the largest in the history of the iron industry in this country, amounting to 9,579,779 tons of 2,000 pounds, as compared with 3,781,021 tons produced during the census year 1880, and 2,052,821 tons during the census year 1870.

From 1870 to 1880 the increase in production amounted to 1,728,200 tons, or nearly 85 per cent, while from 1880 to 1890 the increase was 5,798,758 tons, or over 153 per cent.

The pig iron industry of New England has been practically stationary during the last twenty years.

Pig iron is now made in twenty-five States and Territories.

Pennsylvania produces about one-half of all the pig iron made in the United States.

Ohio retains second place, dropping, however, from 14 per cent in 1880 to 13 per cent in 1890.

Alabama advances from tenth place in 1880 to third place in 1890. Her increase over 1880 is 1,328 per cent.

Illinois, which was seventh in rank in 1880, is fourth in 1890.

New York retires from third to fifth place. Virginia advances from seventeenth to sixth, and Tennessee from thirteenth to seventh.

As showing the greater size and capacity of furnaces in 1890 over those of 1880, the fact is demonstrated that, while the production of 1890 was 5,798,758 tons greater than that of 1880, the number of completed furnaces actually decreased from 681 in 1880 to 562 in 1890. In other words, the average yearly capacity in 1880 was 5,552 tons, while the average yearly capacity of furnaces reported in 1890 was 17,046 tons.

The nine Southern States produced only 350,436 tons in the census year 1880. In 1890 they produced 1,780,909 tons, an increase of 408 per cent.

Kentucky alone, of all the Southern States, shows a decrease in production, amounting to 25 per cent.

Six Western States, Illinois, Indiana, Michigan, Missouri, Ohio and Wisconsin, produced in 1890 2,522,351 tons, against 995,335 tons in 1880, an increase of 153 per cent. Indiana, alone of these States, reports a falling off, amounting to 37 per cent.

During the decade, the use of anthracite has fallen off 71 per cent, while the use of mixed anthracite coal and coke has increased 163 per cent, coke and bituminous coal 343 per cent, charcoal 51 per cent, and castings direct from furnace 135 per cent.

Of Ohio's product in 1879, viz., 1,302,299 tons, the Mahoning Valley produced 527,164 tons, or nearly half.

The production of Bessemer pig iron in the United States during the census year 1890 amounted to 4,233,272 tons, of which Pennsylvania made 2,567,813 tons; Illinois, 616,654 tons; Ohio, 516,654 tons; and other States much smaller quantities.

One hundred and forty-nine thousand, nine hundred and fifty-nine tons of spiegeleisen were produced in the census year 1890.

The Prismatic Fountain at Lincoln Park.

The electrically illuminated fountain at Lincoln Park, Chicago, has been completed and is in operation nightly. Numerous jets of water are projected skyward to varying heights, and are kept continually changing, rising and falling irregularly, breaking and splashing, falling in sheets and breaking into spray while being illuminated with various colors that are continually changing, the effect produced suggesting the idea of shattered rainbows caught by a whirlwind. At times some of the jets leap fully 100 feet into the air, blowing for a time, while the falling drops sparkle in the vari-colored lights with the brilliancy of gems of the purest water. At one instant the streams will blend in a manner that suggests an iceberg, sparkling with its frosty crystals under the beams of white light, then instantly changing to a beautiful emerald or deep crimson. At other times the colors change so rapidly that the mind becomes weary in the effort to recall the names. For an hour the display continues ever-varying, never the same for longer than a few seconds, barely sufficient to allow the mind to obtain the impression, not long enough to permit one to realize the real beauty of the scene. The ever-varying changes of the forms produced by the jets in their varying irregularity, and the play of the numerous colors, reminds one of the glimpses of fairyland as presented in the spectacular dramas.

How is it all produced? Simply enough. Below the reservoir which receives the water from the fountains is a room about thirty feet square having a cement floor, while the ceiling is but seven feet above. A long, narrow tunnel leads to this, and on one side are arranged numerous pipes and valves for supplying and controlling the water that forms the jets. Around the sides of the room and through the center are numerous arc lamps, placed in a horizontal position, and fitted with silvered reflectors. Above the lamps are cylindrical tubes 18 inches or more in diameter that lead above the surface of the water in the reservoir. Near the bottom of the reservoir the pipes that furnish the water are laid, leading into the large tubes so that the jets and streams spout upward from their mouths. A thick plate of glass in the tube prevents the water from entering the room below. Beneath each tube is a lamp, the concentrated rays being projected through the glass plate. Between the lamps and tubes are frameworks carrying slides which contain large panes of different colored glass. Men stationed in different parts of the room keep changing the slides that produce the colors in the water. The valves, which are of the lever type, are changed continually by men stationed there for that particular purpose. There are fifteen arc lamps in the room, each under a separate tube. These lamps use ⅝ inch carbons and are connected up in series. They are adjustable by hand, but require very little attention to keep them in operation. This fountain and apparatus was presented to Lincoln Park by C. T. Yerkes, president of the North Side street railway system. Lincoln Park has always been a favorite resort on account of its beauty and the many interesting features which make it a pleasant place by day or night, but the most frequented part in the evening is the vicinity of the electrical fountain.—*Stationary Engineer.*

The Double Turret Monitors.

The popular interest excited of late in our new and fast unarmored cruisers, the San Francisco, the Philadelphia, and the Baltimore, and also in the great battle ships and other remarkable war vessels recently planned, has naturally drawn attention away from the five double turret monitors. But the pioneer of this class of ships is now practically completed and can be made ready at very short notice for her trial trip, which in any event will probably take place within a few weeks. The keel of the Miantonomoh was laid, as were the keels of her sister ships, the Monadnock, the Amphitrite, and the Terror, as long ago as the year 1874. They and their larger associate, the Puritan, have experienced many vicissitudes in policy and many changes in plan regarding them during this long interval, and at one time they fell into such disfavor as to acquire in some quarters the nickname of the "fraudclads." But they have come out of their long trials in reasonably creditable fashion, and, in the opinion of many naval experts, will prove very good auxiliaries for harbor defense. The Miantonomoh, just now the center of interest among them, has, like her three sister ships, a length of 250 ft., with a beam of 55½ and a mean draught of a little over 14. This gives a displacement of 3,815 tons. With an iron hull, she has English compound armor, made for her by Brown & Co. and Cammell & Co. about five years ago, when no suitable plates could be promptly turned out in the United States. This armor is 7 inches thick on the sides of the vessel and 11½ on the turrets. The armor for the three other vessels of the same type will be of American manufacture, their completion having been undertaken later. They all have armored decks 2 in. thick, covered with wood, and their conning towers and ventilators will be protected by from 9 to 10½ in. of armor. The turrets are protected in their revolving machinery much more than under their original design. Good engines will give sufficient speed for the purpose to which they are devoted, that of coast and harbor defense.

How much in practical efficiency is to be expected of the Miantonomoh and the other monitors of her type? We are confronted at the start by the fact that with the exception of the big Puritan, which has been so altered that she is hardly of the same class, these vessels have only seven inches of side armor. This is a very imperfect supply for a modern armorclad, and it would not be repeated in any newly designed vessel. Still, when we reflect that their freeboard is only a little over two feet, it becomes evident that this low hull, protected with good armor, is a hard target to hit. Again, these vessels are of very light draught, especially as compared with that of the great foreign ironclads, which are the opponents they would chiefly fear. Hence they could take advantage of the shoal waters along our coasts, and might be maneuvered in such a way as to gain an advantage over more powerful adversaries from the course the latter might have to take. And while their hulls are low, the turrets, which are more exposed to hostile fire, have 11½ in. of modern armor, aided by their cylindrical shape. These vessels carry batteries that should make them formidable adversaries. Each will have four 10 in. rifled breechloaders, which, with a charge of 250 pounds of powder, a muzzle velocity of 2,100 ft. per second, and a muzzle energy of more than 15,000 foot tons, will be able to perforate fully 21 in. of wrought iron at a distance of 1,000 yards. Three of the Miantonomoh's guns are ready, and the fourth can soon be completed.

The other double turret monitors are less advanced. Foremost among those of 3,815 tons displacement is the Terror, which will soon receive her machinery. The Amphitrite and the Monadnock, the former of which is to be completed at Norfolk and the latter at Mare Island, will hardly be ready under two or three years. The Puritan has been turned into a powerful barbette ship. With a length on load line of 281 ft., an extreme beam of a little over 60, and a draught of about 18 1-5, she will have a displacement of 6,060 tons. Her turret armor will be 11¾ inches thick and that on the hull will have a maximum of 14, while powerful engines will give her a speed of at least thirteen knots. She is likely to carry a battery of twelve-inch guns. As to the Miantonomoh, even were there no other interest attaching to her approaching trial trip and her subsequent commission for service, the fact that she will carry the heaviest guns ever afloat in our navy will bespeak for her a large share of public attention. She may already be counted upon as one of the most important factors in the defense of New York Harbor, which, with this vessel and the new shore batteries for rifled guns and mortars now about to be constructed, begins to see its sources of at least partial protection assembling.—*N. Y. Times.*

A Check is not Cash Payment.

The Supreme Court of Minnesota has lately rendered a decision of much interest to the business community in declaring that bank checks are not cash, and do not possess legal value as money until cashed. In other words, the giving of a check on a bank is not a payment when passed between debtor and creditor, but only becomes so when the money is received on it.

The court holds that in accepting a check from a debtor there is no legal presumption that the creditor takes it in absolute payment, but only conditionally, or as a written acknowledgment of the debt. Where goods are sold for cash on delivery, and the purchaser tenders payment in a check or draft on his banker, such payment is only conditional; and the delivery of the goods, if made, is also conditional. If the check is dishonored on presentation, the seller may retake the goods for the purchase money, even from the possession of a third or innocent party, unless it can be shown that the seller has been guilty of such negligence as would estop him from recovering in equity.

This decision is among the first rendered by higher courts that is so far-reaching, and if supported by other high tribunals, will settle a mooted question in commercial circles. The same principle has been applied to unpaid notes by one or two courts, which have held that the seller does not lose his lien, for purchase money, on goods sold, until he receives the actual cash, and may retake at any time prior thereto if the indebtedness be not met at maturity.

Overthrow of the German Telephone Monopoly.

Until lately the German post office arrogated to itself the sole right of erecting or licensing private telephone installations, thus prohibiting the development of a most convenient means of communication and excluding legitimate industry from a branch which ought to be its domain. The well known telephone manufacturing company, Actien Gesellschaft Mix and Genest, Berlin, determined on principle, and in the interests of the telephone world at large, to try the point in a court of law. To this effect they brought an action against the German government (Reichsfiskus), claiming that: "It (the German post office) had no right to restrain or prohibit the plaintiffs to erect and maintain private telephone installations (*a*) between buildings belonging to the same landlord but situated at a distance from each other and separated by property of other land owners, or by public roads or otherwise; (*b*) between property belonging to different landlords, *i. e.*, from one part of a city to another." This claim was decided on July 10 in the Royal High Court of Justice (Konigliches Landgericht I) of Berlin entirely in favor of the plaintiffs, thus putting an end to a state of things which has lasted too long to the disadvantage of all those interested in this daily progressing industry.

New Mexico Onyx.

Mrs. L. J. Caldwell, of Chicago, is the sole owner of ricolite and green onyx quarries now being operated in western Grant County, New Mexico. This is one of the most remarkable discoveries. The stone has the form of true fissure vein fifty feet wide and over a mile in length, and it is taken out in massive blocks and taken to Chicago, where it is becoming very popular for house decoration, inside and outside. The stone is susceptible of a very high polish, and of a variety of colors—dark green and cream, striped and mottled, also pink and salmon. In fact, it carries what are termed the "lost colors" in stone. It is very tough, is superior to Mexican onyx, and is the only stone of the kind in the world that can be carved. Contracts have been signed to supply it to the new Alhambra theater and hotel and other public buildings in Chicago for decorative purposes. Mrs. Caldwell offers blocks of it to be used in the construction of the New Mexico exhibit pavilion at the world's fair.—*Stone.*

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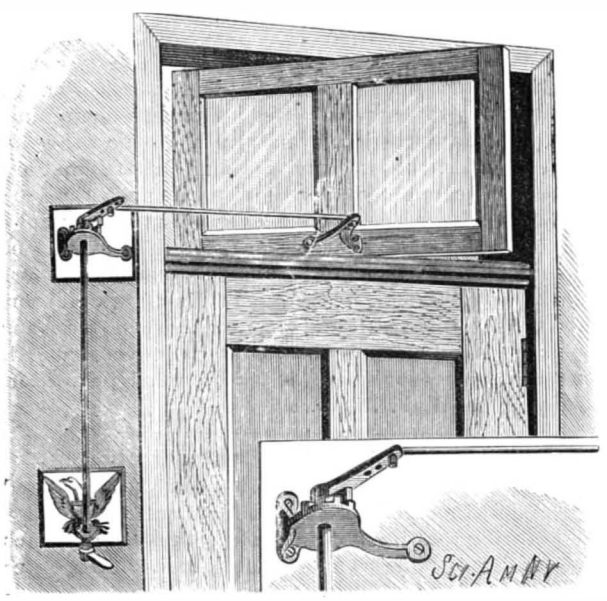
A DEVICE FOR MANIPULATING DOORS AND WINDOWS.

A device which will serve to lock a door or window in place when opened or closed, and to move it into any desired position, is shown in the accompanying illustration, and has been patented by Mr. Emil Herz of No 657 East 157th Street, New York City. A vertical shaft is mounted to turn and slide in brackets, one

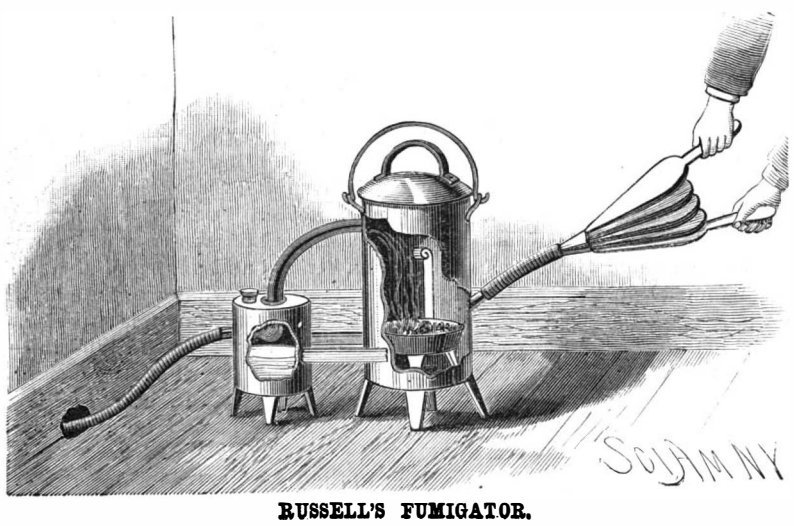


HERZ'S TRANSOM MANIPULATOR.

above the other on the door casing, there being on the lower end of the shaft a handle, while at its upper end is an arm pivotally connected by a link with a bracket fastened to the door or window. On the under side of the arm, at the upper end of the vertical shaft, is a lug adapted to engage one of a series of notches arranged in the segment of a circle on top of the upper bracket, there being on the outer end of the bracket a stop to limit the movement of the arm. This arm has also, near its outer end, a series of holes for the insertion therein of one hooked end of the link, the other hooked end thereof being inserted in one of a number of holes in the bracket fastened to the door or window, for the proper adjustment of the device. To either open or close the door the operator pushes up on the handle, raising the vertical shaft a short distance, when it may be turned by the handle in the desired direction, the lug on the under side of the arm at the top of the shaft coming to rest between notches on the upper bracket when the handle is released, thus holding the door or window in the position to which it has been moved.

AN IMPROVED FUMIGATOR.

A fumigator for exterminating animals burrowing in the ground or living in holes is represented herewith, and has been patented by Mr. Lee Russell, of Luling, Texas. It consists of a suitable receptacle mounted on legs and having a removable top, there being a removable fire box in the bottom of the receptacle. Directly above the fire box is an inlet pipe, connected with bellows by a flexible tube, and from the opposite side leads a pipe opening into the top of a small vessel containing water, a flexible tube from the latter vessel leading to the opening or hollow supposed to communicate with the animal's nest. When sulphur is thrown on the burning fuel, and the bellows started, the lid being placed on the main receptacle, the fumes are driven into the smaller vessel and thence to the animal's nest, any sparks passing off from the fire being extinguished in the second vessel, thus removing any danger from fire to a building in which the apparatus may be used, the second vessel not being needed when the fumes are directed immediately into the ground.



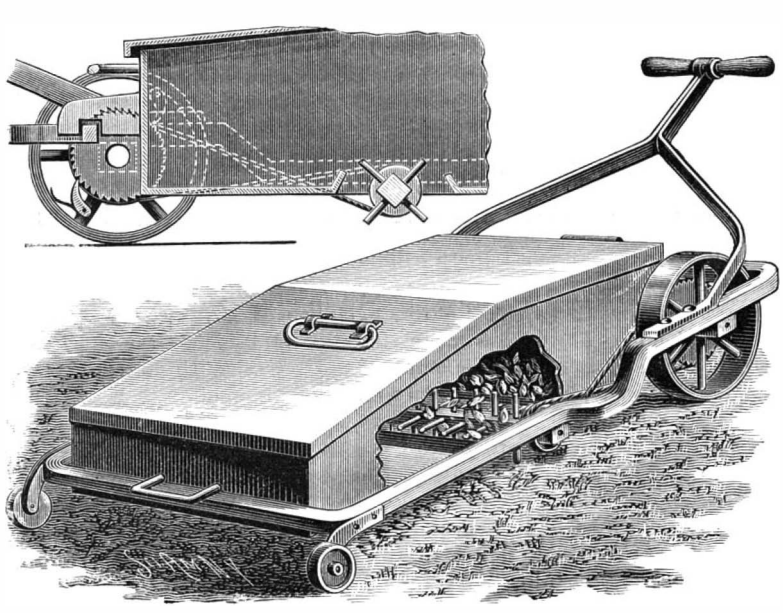
RUSSELL'S FUMIGATOR.

Amidships Propeller.

A trial trip of the Dhui Heartach, which has been altered and adapted to test the advantages to be gained by having the propeller amidships, instead of as by the recognized method, viz., at the stern, was recently made from Hartlepool to the Newcastle Quay. Although the vessel was quite light, not even ballasted, she behaved admirably. It was manifest that perfect contact with the water, under the ship, was at all times certain for the propellers, so that there was no racing or unequal strain upon the engines. In fact, whether rolling or pitching, the propellers were never visible, nor was the surface of the water directly over the propellers ever broken, and the manifest disturbance to those who were on board was only that of a mere bubbling round to the stern of the vessel. Therefore there was no turbulence in the neighborhood of the rudder, and steering was a mere pastime, the ship answering easily and quickly to her helm. The vessel is now in the Tyne, being further tried and examined.

AN IMPROVED LAWN CLEANER.

The illustration represents a machine designed to effectually clear grass, leaves, etc., from lawns and similar places, and which will take up the grass cut by a lawn mower, leaving the lawn perfectly clear. It has been patented by Mr. Charles Bailey, of 6 Colony St., Winnepeg, Canada. The frame of the machine is preferably made of bar iron, and in its side bars, near the rear, is journaled a shaft on which the drive wheels are keyed. On this shaft, near one of the wheels, is loosely mounted a grooved pulley, having a toothed periphery contiguous to the drive wheel. This toothed periphery is engaged by pawls pivoted upon the drive wheel when the machine is moved forward, thus revolving the pulley, but when the machine is drawn backward the pawls slip over the teeth. Near the center of the frame is journaled a rake head, with teeth projecting at right angles from its sides, as shown in the small view, one end of the rake head having rigidly attached thereto a small pulley connected by a belt with the pulley on the drive wheel shaft. As the refuse is thrown



BAILEY'S LAWN CLEANER.

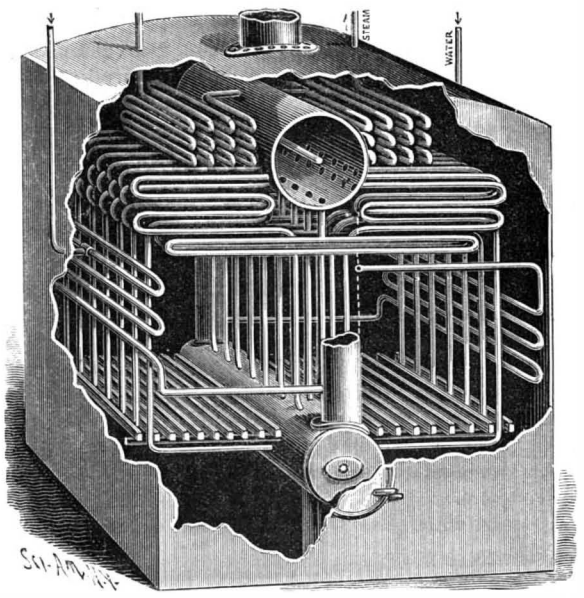
upward by the rake when the machine advances, it is received in a box-like receptacle provided with a detachable cover, this receptacle neatly fitting within the frame of the machine, and having a transverse bottom opening within which the rake revolves. When the box has been filled with grass, leaves, etc., it may be lifted from the frame, the cover removed, its contents emptied, and the receptacle again replaced without trouble.

AN ERASER FOR USE ON BLACKBOARDS.

The engraving shows a simple and inexpensive device for erasing chalk marks from blackboards, which has been patented by Mr. Joseph H. Thompson, of Wilmington, Ohio. The facing of the eraser is made of strips of cloth or felt folded upon each other in elongated form, and having their upper edges glued to a flexible back of canvas, rubber or other suitable material, the ends of the backing being lapped to form eyes through which pass cross bars of the handle. The latter is made of spring wire, in such form as to make its sides elastic, and on the top of the back is a rectangular wire frame, thus forming a spring back which readily gives to any pressure applied to the handle when the facing is rubbed on the blackboard. For further information address Thompson & Davis, Wilmington, Ohio.

IMPROVED STEAM BOILER.

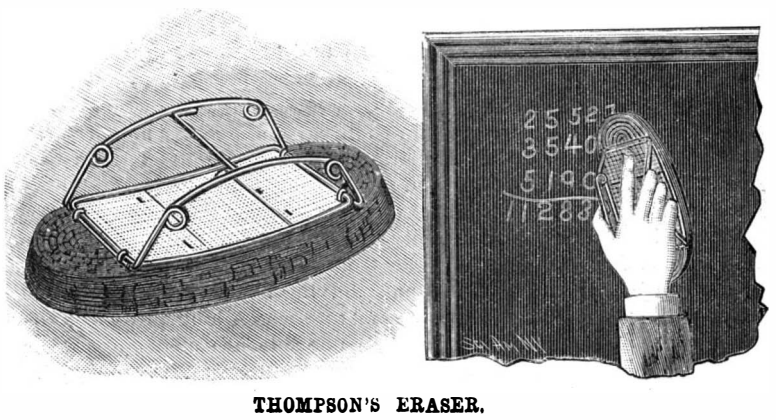
The illustration shows a boiler especially adapted for marine purposes, and designed to insure a perfect circulation of the water and present a large heating surface. It has an upper steam drum connected with a water drum by a large vertical tube at each end, on the sides of which are the fire boxes, the grate bars being a little above the middle of the lower drum, from which pipes extend horizontally under the grate bars and then upward on the outer sides of the fire box, to form coils constituting part of its top, and connecting with the lower part of the steam drum. A second series of pipes leads from the water drum upward on the inner sides of the fire boxes, and forms transversely extending coils connecting with the steam drum at a slightly higher point, but below the water level in the steam drum; also, connecting the bottom of the steam drum with the top of the water drum, is a series of pipes each having transversely extending bends at the top of the fire boxes and under the coils extending from the side pipes. The feed pipes on each side of the casing extend inward to connect with a longitudinal coil, the upper end of which connects with the large vertical tube at one end, while the other lower end of the coil connects with the opposite tube at the other end of the boiler. At the sides of the steam drum are longitudinal coils of pipe through which the steam is passed when taken from the upper part of the drum, that the steam may thus be superheated in passing to its destination. The heads of the water drum have manholes to facilitate the removal of sediment, and in one of the heads of the steam drum is a plug to permit the introduction of a hose to clean the steam drum and the pipes leading therefrom to the water drum. By means of this construction a complete circulation of cold water takes place from the steam drum downward through the large end tubes to the water drum, the heated water passing upward through the several series of pipes, where its temperature is rapidly raised by the heat generated in the fire boxes.



CONEKIN'S STEAM BOILER.

For further information relative to this invention address the patentee, Mr. Dawson Conekin, No. 52 Woodhull Street, Brooklyn, N. Y.

AN exchange says that on the average, in frame dwellings, building hardware, porches, and piazzas should last 20 years; outside paint 5 and inside 7 years; shingles and outside blinds 16 years; cornice and base 40 years; weather boards, doors, windows, stairs, newels, and inside blinds 30 years; sheathing and dimension lumber 50 years; sills and first floor joists 25 years.



THOMPSON'S ERASER.

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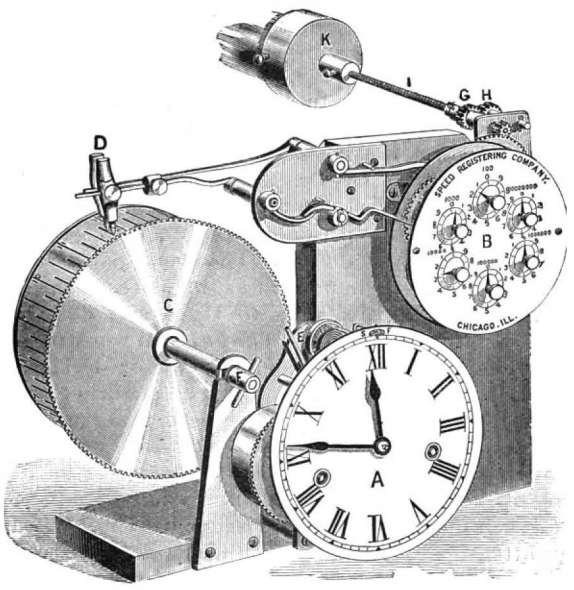
A REGISTER AND RECORDER FOR REVOLVING SHAFTS.

The illustration represents a mechanism, patented by Mr. Solon M. Terry, of Pittsfield, Mass., for registering the number of revolutions of a shaft running any kind of machinery, and also for registering any inequalities which may occur in the speed, recording also duration



THE TERRY SPEED REGISTER AND RECORDER.

of stop, the time of day and the day of the week when the irregularities or stoppage occurred. It is probable that there are but few manufacturing concerns in the country which would not save money, and some of them very considerable amounts, by the use of a device for the purposes accomplished by this mechanism. At the present time competition in all industries is exceedingly close, and the manufacturer who does not look carefully after all the small wastes in his business has but little chance of success. The wastes occurring from running below speed, from irregular speed, and from stoppages, where many hands are employed, are items that too often escape proper attention, and in many cases the employers probably have no conception how large a figure they make, while there are probably few shops run with such regularity that the introduction of such a mechanism would not contribute to an increased efficiency.

The registering mechanism, B, includes a front and rear metallic disk, in which is journaled a shaft carrying a large toothed wheel back of the rear disk, this wheel being adapted to mesh with a pinion, G, to be driven by the drive shaft whose revolutions are to be recorded. This pinion is preferably on one end of a short flexible shaft, I, on the other end of which is a cap, K, to be tightened on the driving shaft. There are ten times as many teeth on the large toothed wheel as on the pinion, so that it requires ten revolutions of the drive shaft to turn the large wheel once. In the disks are journaled five other shafts, each having a pinion and intermeshing gear, so that the first shaft turns the second, the second turns the third, and so on up to the sixth, each shaft, by its complete revolution, turning the following shaft only one-tenth of a revolution. The outer ends of the shafts extend through their bearings in the outer disk, where their ends are tapered and a dial, B, is secured with six separate scales, or one for each shaft, an indicator hand being so secured by an adjustable cap to the end of each shaft as to rotate therewith, while it can be readily turned back, when it is desired to start the hands anew at O, by a firm pressure of the fingers. Upon one of the shafts is a lug, and on the main back plate is pivotally mounted a lever adapted to be tripped by the lug with each revolution of such shaft, the lever having on its other end a sharp point or marker, D, normally held in contact with a strip of paper on a recording drum. Upon the main vertical back plate of the registering mechanism is mounted a clock, A, the mainspring shaft of which is extended to the rear and carries a broad-toothed gear wheel adapted to give motion to the recording drum, C. This drum is designed to make two revolutions in twenty-four hours, and has a central longitudinal screw-threaded aperture, in which fits a screw arranged to give a lateral motion to the drum as it is rotated by the gear wheel on the mainspring shaft of the clock, so that each succeeding row of marks or perforations made by the marker will be separate and distinct from the preceding row. Upon the periphery of the drum is removably secured a record strip, which preferably has the days, hours, and divisions of hours printed thereon for a whole week, as partly shown in the diagram, which is a sample of a record as made according to this invention between the hours of 1 and 3:30. The speed of the drive shaft at the time this record was made was 200 revolutions per minute, and the absence of marks on the record at 2:20 Thursday indicates a stoppage of the shaft at that time. The clock employed in connection with this register is a superior eight-day marine movement, with a double spring, and when once adjusted in the position it is to occupy, is designed to make an absolutely perfect record, showing not only the times of regularly starting and stopping the machinery and all intervening stoppages, but the exact rate of speed for each portion of every hour during the week, whether this comes from great differences in the work done, or low or high pressure steam in a steam engine, or a variable flow of water in a water wheel plant. The entire registering and recording mechanism, except its connection with the drive shaft, is inclosed in a substantial case, the key to which may be kept by the factory owner or superintendent.

This device is manufactured by the Speed Registering Company, of Chicago, Illinois, and is being placed with manufacturers at a low rental, by Mr. S. H. Pomeroy, general agent, Pittsfield, Mass.

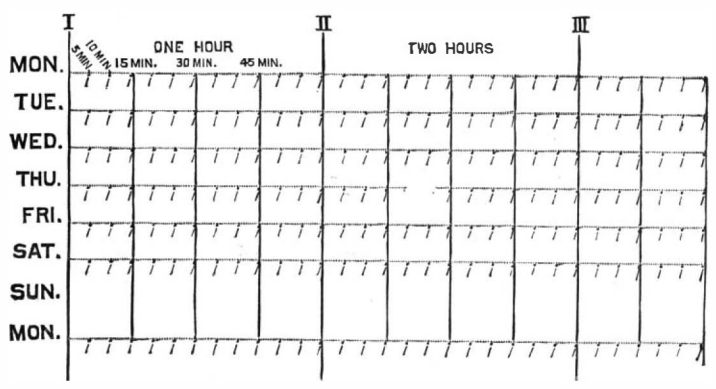
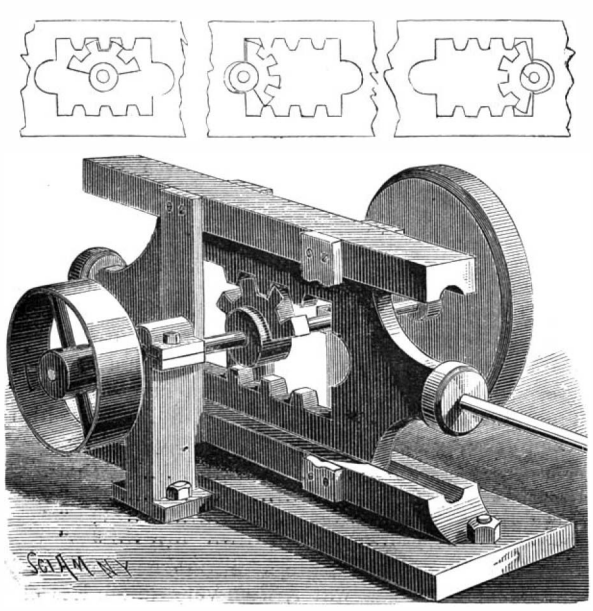


DIAGRAM OF RECORD MADE BY THE TERRY SPEED REGISTER AND RECORDER.

AN IMPROVED MECHANICAL MOVEMENT.

A device for converting reciprocating into rotary motion, avoiding all dead centers, and designed to transmit power without any undue friction or lost motion, is shown in the accompanying illustration. On the base plate is arranged a longitudinally extending guideway, vertical plates from which support at their upper ends a second guideway, and in these ways slides a frame having heads at each end, the rod connected with the machinery furnishing the reciprocating motion being secured to one of the heads. Within the frame is an essentially rectangular opening, the bottom and top sides of which each have three rack teeth, while the inner ends thereof are centrally recessed, and have top and bottom shoulders. The top and bottom rack teeth are adapted to be alternately engaged on each forward and backward movement of the frame by the teeth of a segmental wheel secured on a transverse shaft, having a fly wheel and the usual pulley connected with the machinery to be driven. The small views represent the manner of contact of the teeth of the segmental wheel with the rack teeth and shoulders of the sliding frame at different positions of the reciprocating rod, whereby a continuous rotary motion is imparted to the transverse shaft.

For further information relative to this invention address Mr. James Hayton, the patentee, No. 3 Mortison's Avenue, Fifth South, between Second and Third East, Salt Lake City, Utah.

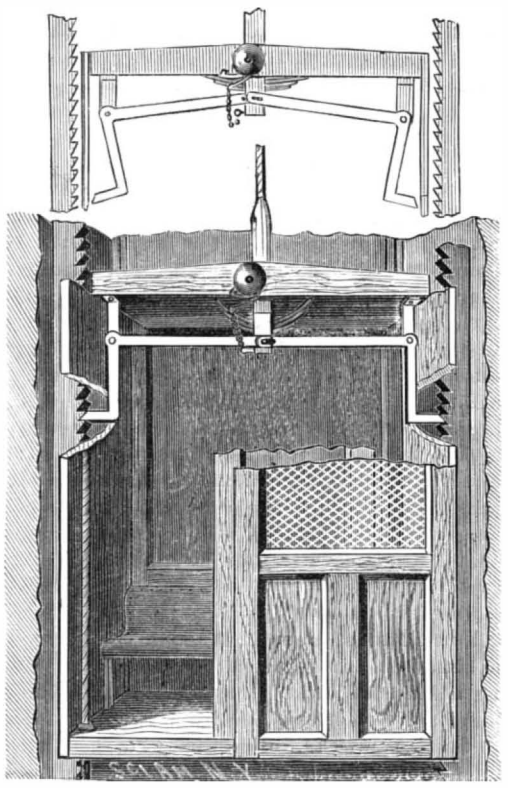


HAYTON'S MECHANICAL MOVEMENT.

SIR CHARLES PALMER says, thirty years ago, 7·47 men were employed in British steamers per 100 tons, whereas to-day the ratio is 2·88 men per 100 tons. In 1850 the total of steam tonnage owned in Britain was 167,698 tons, and last year 4,717,730 tons.

AN IMPROVED SAFETY INDICATOR FOR ELEVATORS.

The illustration represents a simple and practical device whereby the condition of the automatic safety attachments to a passenger or freight elevator will be

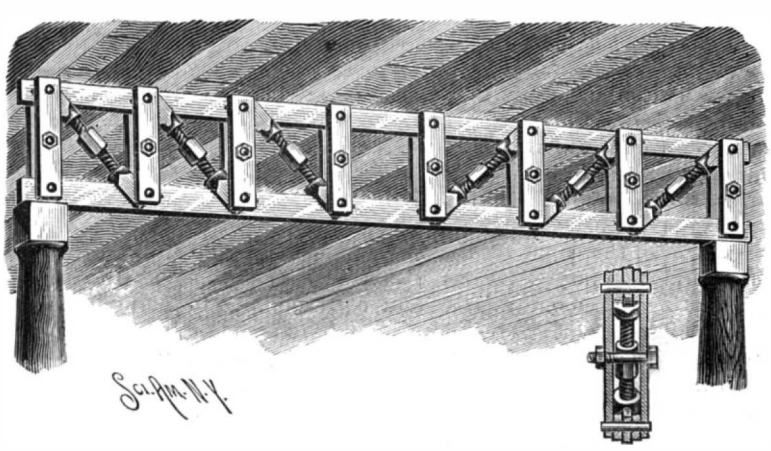


LYNN'S SAFETY INDICATOR FOR ELEVATORS.

audibly manifested at every reciprocal movement of the elevator car. It has been patented by Mr. Joseph Lynn, of No. 275 Walnut Street, Holyoke, Mass. To the opposite side walls of the elevator shaft are secured toothed racks adapted to permit an upward sliding movement thereon of the toes of bell crank levers, while preventing any downward movement when such toes are brought into engagement with the teeth of the racks. These levers are pivoted at their corners upon depending bracket arms secured on the under side of the top cross bar of the car, their inner ends being lapped upon each other and longitudinally slotted where they have contact with and are loosely secured by a bolt to a central bracket block. This block at its lower end forms the support for a semi-elliptic leaf spring, the ends of which bear upon the lower surface of the cross bar. The elevator cable is secured to the upper end of the block, which slides up and down through the cross bar with the movement of the spring. The spring is compressed, as shown in the top view, when the elevator car is suspended from the cable; but when the car is seated on the shaft bottom, the spring assumes the position shown in the main view, the toes on the crank arms being then projected outward, a position which the springs would likewise cause them to assume, and stop the downward movement of the car, in case of the breaking of the cable with the car suspended therefrom at any point in the shaft. To prevent accident from an inoperative or defective condition of the spring, an alarm or signal bell is provided, to be struck by a crank hammer operated by a flexible connection with the block supporting the spring, so that each time the cable is slackened the downward movement of this block will cause the bell to be struck. Should the bell fail to sound on the car reaching the bottom of the shaft, the absence of the signal would be an indication of a defect calling for immediate attention. It is evident that this safety indicator can be used in connection with any form of safety clutch besides the one shown in the illustration.

AN IMPROVED LIFTING TRUSS GIRDER.

The illustration represents a contrivance by means of which it is possible to raise floors, ship decks, etc., which, through sagging, have dropped below their



OLSEN'S LIFTING TRUSS GIRDER.

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proper level at or near the middle, or it can be fastened underneath, on the side of, or above a joist, or on the side of a wall, and be made to bring an immense pressure to bear in any desired direction. In its construction are employed horizontally extending stretchers, preferably made of steel or iron, and pivotally connected by vertical links, the latter being connected at their centers by transverse bolts. Extending obliquely between the stretchers are turn buckles which have bifurcated end portions embraced between opposite ends of adjacent links at the points of connection between the latter and the stretchers, as shown in the sectional view, the pivots extending not only through the end portions of the links, but through the bifurcated portions of the turn buckles and through the stretchers. Comprised in the turn buckles are screws having oppositely threaded portions, which extend in reverse directions and engage screw-threaded apertures in the bifurcated portions of the turn buckles, there being combined therewith central hand pieces, shown of octagonal form. By means of the hand pieces the screws may be rotated to cause the bifurcated portions of the turn buckles to be moved nearer to or further from each other, when the stretchers will be correspondingly bowed or curved. This lifting truss girder may also be made with four stretchers, and can be made very strong and light, to suit any purpose. By manipulating the screws the girder can be bent both ways; if put under a floor that has sagged, the girder can be bent to fit, until properly fastened, and then by turning the screws in the opposite direction the floor will be brought to its proper level. After its proper manipulation it may, if desired, be permanently left in place to uphold the flooring or whatever else it may be applied to.

For further information relative to the above invention, address Mr. A. Olsen, the patentee, Ephraim, Utah Territory.

A Science Theater.

BY PROF. RUFUS B. RICHARDSON, PH.D.

Germany is not generally looked upon as the land of novelties; but Berlin possesses one novelty so important that it seems worthy of attention and description. Every day one sees on each of the several thousand large wooden columns standing at almost every street corner, along with the other theater announcements, the following: "Urania, in the Science Theater (*Wissenschaftliches Theater*), at 8 P. M.; The Primeval World," or, on another day, "The Journey from the Earth to the Moon." If one follows this standing invitation, he will see something interesting. If he chooses the "Journey to the Moon," he will find that he has a popular lecture on astronomy actually put upon the stage.

In the place of actors, to be sure, one finds a single reader or declaimer, who mounts a desk in front of the curtain and gives the lecture to the audience; but all the scenic effects which the stage affords are called in to aid the lecture. After a short prologue on the purpose of the lecture, the curtain rises on a scene near Berlin on the morning of the last great eclipse of the sun, August 19, 1887. Morning twilight comes on. The world begins to stir in anticipation of the usual sunrise, when lo! in the place of the usual sun, up comes a blood-red sickle, which soon disappears, and weird lights appear around a black disk. Nature is shrouded in a veil worse than pitch darkness. Animals feel the terror which men uninstructed to look for such a phenomenon used to feel. The tension is soon relieved by the reappearance of the sickle reversed, and the gradual passage into an everyday light. The lecture all the while proceeds, explaining the cause of the strange phenomenon; *i. e.*, that the moon has come between the earth and the sun. Attention being thus fastened upon the moon, the spectators are made to approach that body by successive scenes.

The next scene affords a look at the earth from a point of view in space at some distance from it. We now see how the same eclipse appears from this point, and see the shadow of the moon sweeping over a small area of the great revolving globe, moving eastward from Berlin over the Russian border, taking its course between St. Petersburg and Moscow into Asia, where we leave it on the dropping of the curtain. In the next scene one sees an eclipse of the moon from a point in space where he beholds both earth and moon in their relative size, and sees the moon pass into the broad shadow of the earth. Thus by two successive stages one is brought nearer the moon, until he sees it as the most powerful telescopes present it. With the mountains all spread out before the sight, a disquisition on the moon's surface is intelligible and impressive.

Not to give every detail, one is at last introduced to the surface of the moon itself. The grandeur of that dead world is an impressive scene. Then comes a scene representing the moon by earth light, corresponding to our moonlight night, resolved into sunlight at the close of the scene, as the sun rises wasting his glory on those desert fields. Then we are shown an eclipse of the sun as seen from the surface of the moon, or how things look there on the occurrence of what we call an eclipse of the moon.

Returning to the earth with a comfortable "home again" feeling, but with a new interest in all the operations of our satellite, we have a magnificent scene in the High Alps, sunset, evening glow, and following eclipse of the moon, in which the disk is seen still dull red in the earth light, which we had already seen surrounding us when we witnessed from the moon the same occurrence, or what there appeared as an eclipse of the sun by the earth.

Then comes the closing scene, a sunset in St. Paul, a volcanic island of the Indian Ocean, accompanied by a comparison of the so-called volcanoes of the moon with those of the earth. The scene painter has exhausted his art to leave on the mind of the spectator an impression of the glory and beauty of earth encircled by sea and sky and lighted by the glorious sun. The two hours' instruction closed with an appeal to the feelings. The same chords are touched upon which great Nature plays in summer evenings when we have all felt more than we can express.

The other representation, "The Primeval World," a lecture on geology, is incomparably more effective in its scenic display. The twelve scenes present the world in its various conditions from primeval chaos down to the present, with the convulsions through which it passed. It would be tedious to catalogue each scene. Particularly grand is a "Volcanic Outbreak of the Devonian Age," which changes the whole face of nature. Impressive also are the "Forest of the Carboniferous Age" and a "Jurassic Landscape," with its giant lizards. When the eleventh scene presents the "Lake of Zurich," with the morning sun rising upon a simple community of lake dwellers, one feels that the reign of monsters is over, and wants to rise and shout "Hurrah for man!" But when a Mediterranean shore is introduced crowned with eloquent ruins, and pensive music fills the air, the feelings are toned down, and the spectators are sent home in somewhat of that quiet, thoughtful frame of mind in which the old Greek tragedy was supposed to leave them.

The story of the origin of the Urania Institute, of which the theater is only one branch, is a very interesting one. Some years ago Professor Forster, the director of the Berlin Astronomical Observatory and a professor in the university, was troubled by the great number of people, not students, who wished to look at the moon and other heavenly bodies through the observatory telescopes. It did not seem right to shut them out. Germans always have sympathy with one who "wants to know." The observatory management proceeded in a patient German way to take applications and to accommodate the applicants in order so far as possible. But the calendar became clogged with applications six months in advance. Professor Forster appealed to the government, the first and natural resort of a German, for an appropriation to set up telescopes in a separate building, to supply the evident demand. He failed to secure the appropriation.

After this there gradually matured in his mind and the minds of several of his associates the idea of an institution of popular instruction, with not only telescopes but a great quantity of physical apparatus. Then came the thought of calling in that great auxiliary, the stage. Thus what, as a benevolent enterprise confined to the simple scope of giving people a chance to look through telescopes, was about to be abandoned for lack of funds now became a promising financial venture. A stock company was formed, and the result was the Urania. It has already been in operation a year, and has, I am told, paid eight per cent on the investment. Yet so strong is the feeling that an educational institution of this sort should be supported by the State, that the proprietors still talk of having the government take it off their hands and give it an assured durability.

The actuating motives of the projectors of the Urania were not mercenary. The movement was in *spirit* rather like that of the University Extension movement in England. These men felt that a good deal of the pleasure of the poorer people of Berlin was rather crass. To the minds of many, beer drinking has a proper limit, which has been widely overstepped in Germany.

Then, again, the larger theaters, particularly the Royal Theater, supported by the government, though powerful educational aids, could not reach the poor, who could not afford to buy tickets. The cheap theater, on the other hand, furnished often cheap stuff, if not worse. Thus came the desire of a cheap theater which should at the same time be above reproach and yet be interesting.

The institute is open from noon until 11 P. M. In the evening before the theatrical representation you may see crowds of Germans who "want to know" investigating microscopes, spectroscopes, phonographs, electric railways; in fact, all sorts of electric and magnetic apparatus, and other apparatus, a catalogue of which would be too long to give. Near each piece are "Directions for Use," and willing directors are also constantly moving about the rooms. The six large telescopes have unfortunately been of little use for most of the summer, as rain clouds hovered over Berlin, dropping rain every day for a month and a half previous to July 14, giving a grim humor to the remark in the "Journey to the Moon" that the view of the moon which is *here* vouchsafed is independent of the weather. It should have been remarked earlier that the eclipse of 1887 is here given as it ought to have been, and not as it actually presented itself.

Occasionally in the place of the stage representation a regular lecture is given. Dr. Schultz-Hencke gives two lectures on photography on two consecutive evenings, with abundant apparatus and experiments on the stage.

The characteristic feature and the drawing power of the institute is, however, its novel theater. The lectures that form the basis of the representations are admirably written by Dr. M. Wilhelm Meyer. But they are probably no better than Professor Young could write. In the Urania, however, they go in at the eye as well as at the ear. The scene painter and the declaimer are as important as the writer of the lecture, who intrusts his work to them, and does not appear before the audience. The one man who appears to be doing the whole thing is the actor or declaimer. This is Karl Bergmann, who was an actor of good standing, but who regards his present position as an important promotion. With a voice of admirable clearness and flexibility, he declaims the lecture as if it were his own, turning confidentially to the audience, using such phrases as "my respected hearers," "I call your attention," etc. If the role which he plays seems in this description of it insignificant, it is not so in fact. Many good scientific lectures are spoiled by bad delivery. The Urania avoids that rock by choosing a man who is a master of the art of delivery.—*The Independent.*

Utilization of Fibers.

A new mode of treating hemp, jute, and other fibers for making materials for the manufacture of tiles, slabs, cisterns, boats, and other articles or structures has been described in a patent specification by B. A. Weatherdon. The fibers are cut and boiled four to six hours in a strong solution of lime by steam at a pressure of from 20 pounds to 40 pounds to the square inch. After being thoroughly washed, the material is passed to a pulping machine, where it is treated with alum, about 7 pounds to 14 pounds to the cwt., and in some cases with animal size, and in others with vegetable or other oils. From the pulping machine it is run into receiving or storing tanks, fitted for machinery for keeping the pulp in agitation, and while therein it can be dyed if required. Now, the pulp fiber is pumped into vats, and from thence into wire moulds, to be formed into slabs, blocks, etc., the liquor being extracted by suitable pressure. The slabs, blocks, etc., are brought into the drying room, and when dry passed through solid steel rollers four to twelve times, steeped in a warm solution of alum, and again subjected to hydraulic pressure. Then they are brought into a bath of vegetable or other oil for four to six hours, and again pressed and steam-rolled as many times as necessary. To finish the process they are dried in hot air, and in some cases passed through the rollers once more.

Toads in Rocks.

Many well authenticated stories of the finding of live toads and frogs in solid rock are on record, and that such things are possible was demonstrated here recently, when the workmen engaged in Varley & Everill's lime rock quarry, north of the city, broke open a large piece of rock which had been blasted out, and a frog hopped out of a pocket in the center of the stone, says the Salt Lake *Herald.* Of course, the occurrence created a tremendous sensation among the workmen, and operations at the quarry were for the time suspended, and the movements of the frog were watched with great interest. The animal was somewhat smaller than the ordinary frog, and was perfectly white. Its eyes were unusually large and very brilliant, but the frog was apparently blind. Where the mouth should have been there was only a line, and on the feet was a dark, horny substance. Mr. Everill at once took charge of the curiosity and put it in a tin can, but the frog died the next morning. He brought it down town, and it was examined with interest by a large number of people, and it was afterward presented to the museum, where it will be preserved in alcohol.

Artificial Sea Water.

Professor Edward Perrier lately communicated to the French Academy of Sciences the results of some experiments made by him at the zoological laboratory of the Saint Cloud normal school, upon the use of artificial sea water for the preservation of marine animals, and especially of oysters, in large aquariums.

The solutions employed have been reduced by him to the following formula for from 3 to 4 quarts:

Chloride of sodium	81 grms.
Sulphite of magnesia	7 "
Chloride of magnesium	10 "
Chloride of potassium	2 "

During the exposition, this solution gave as good results as natural sea water, with very much less expense.

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Correspondence.

Burrowing Sea Urchins.

To the Editor of the Scientific American:

The inland waters between Vancouver Island and the mainland abound in marine life, especially with sea urchins, which are eaten by the Indians who live upon those waters.

The sea urchin is frequently found in burrows, accompanied by clams, cockles, crabs, oysters, etc. They enter the burrow while quite young, and as the mouth of the burrow is frequently quite small, they soon grow too large to get out, and they now conform to the shape of the burrow, instead of the burrow being enlarged by them.

I have never seen a case where there were any indications that the burrow had been enlarged a particle by the sea urchin.

The burrows are made by a species of mollusk, which are found nowhere else than in those burrows, which are sometimes 4 inches deep in solid rock; commencing on the surface in contact with the water, the opening may not be larger than the head of a pin. It gradually increases in size until occasionally they are 1½ inches in diameter. No matter how many mollusks are in one piece of rock, they never interfere with their nearest neighbor.

After the death of the mollusk, and as the action of the water on the rock wears it away and the openings become larger, these burrows form places of retreat for myriads of tiny creatures whenever danger is at hand.

Lynn, Mass. Dr. M. C. S.

A Census Problem.

In the United States one hundred years ago the proportion of persons living in cities to those living in the country was as one to twenty-five. The recent census shows that the present proportion is one to three. This decrease in the rural population is general throughout the country, and has given rise to various theories touching the cause. It is an interesting question. Public attention is directed largely at present to social and economic problems, and their consideration is enlisting careful and earnest thought. It is not always possible to determine the reason from the result, but consensus of intelligent opinion on any question aids in reaching a logical conclusion.

The growing disproportion between the urban and the rural population of the United States may be attributed to a variety of causes. It has been accounted for by some of the most careful students of sociology upon the ground that the social instincts of men draw them together into communities and that the tendency to desert the farm and to seek homes in the towns and cities is due to the distaste for solitude which is common to the human race. This will not entirely explain the phenomenon, although it is doubtless true that it is one of the motives which has helped to bring about the present conditions. Economic influences have also played an important part in causing the change which is so rapidly equalizing the census in the country and the cities. Labor-saving machinery makes it as easy now for one man to produce a thousand bushels of wheat as it was formerly to produce one hundred bushels. The railroad has become the wagoner of the farmer, and the necessity of employing men to haul the products of the soil to market has been practically done away with.

The packing houses now do the most of the butchering for the farmers, the creameries make the butter which he consumes, the canning factory and evaporator work up his fruit, and thus in almost every direction the demand for labor has been curtailed and the work of the farm narrowed down. The vast production of agricultural machinery has drawn the young men from the farm to the manufacturing centers. The multiplication of schools and colleges has attracted the well-to-do farmers to the towns and cities to educate their families. The decreased profits of agriculture have induced many people to abandon farming for more lucrative pursuits. The railroads have brought the rural population within easy touch of the world, and the city, which was once so remote, is now easily accessible, with all of its charms and attractions. These are among the reasons which are assigned for the exodus from the country to the city. Whatever may be the true cause of its decline, the spirit of contentment which once prevailed among the farmers no longer exists. Whether the old conditions of happiness and prosperity which once made agriculture an inviting pursuit will ever return, is a problem which is yet to be solved, and it is a question which may well awaken serious concern.

The brawn and the brain of this nation have come chiefly from the rural districts. The bone and sinew of the country is not derived, as a rule, from the great cities. The most illustrious names in American history are associated with the farm. Washington, Jefferson, Webster, Clay, Lincoln, Grant, and a host of other great men who aided in shaping the destinies of the republic came from the country. The nation cannot view with indifference the influences which may impair the source from which its most sturdy population, mentally and physically, has proceeded. Is there any just ground for the fear that the movement from the country to the towns will long maintain its present volume? Does not the logic of events point to an early reaction? The towns and cities cannot remain crowded beyond their capacity to afford a livelihood to their population. When that point is reached there must be a receding wave, and the movement of population will be in the other direction. There is a basis for the belief that the equilibrium will be restored by the law which makes agriculture the essential source of prosperity and the foundation upon which the commercial interests of the country rest.—*Kansas City Star.*

The Process of Fulling.

BY FINISHER.

The first operation in the wet finishing of a piece of woolen goods is known as fulling. Before the cloth is ready for the fulling mills it must have undergone the two preparatory steps of dry finishing, burling and mending. Then, before the fulling proper takes place, one thing more remains to be done, the great benefits of which are constantly becoming more fully recognized. This step consists in the sewing or tacking together of the selvedges of the piece, before it is run into the mill. There is more than one good reason why this is a wise course, and the careful finisher should take them all into account before he condemns the plan as useless. Since the piece is always turned with the face of the cloth inside, no flocks can come in direct contact with the face of the goods. This is an advantage of no small moment, especially upon light-colored fabrics. Further than this, the soap which is used in fulling is not so likely to strike the face of the cloth sooner in one place than in another, and thus give rise to uneven fulling. Again, since the sides are double and of the same thickness as the center of the piece, they will receive the same amount of pressure and friction, and for this reason full more exactly like the middle of the piece than they otherwise could. Last of all, when the selvedges are thus tacked together with the face of the cloth inside, this face cannot rub and chafe against the sides or rollers of the mill. We are now ready for the fulling process, which has been called the mother of finishing.

There is probably no one operation in the whole range of woolen finishing that exercises such an important bearing on the appearance and value of the finished fabric. It is in this process that the first great change takes place which lays the foundation for all the after-work of the department. Hence it is that if, through ignorance, carelessness or neglect, this foundation be faulty or imperfect, nothing that the finisher can possibly do afterward will serve to avoid the most disastrous results.

The fulling process, together with a knowledge of its application and effects, dates as far back as we have any information whatever concerning textile manufacture. And it is a fact that there has never been a people, civilized or savage, who has used sheep's wool in the making of textile fabrics but has both appreciated and utilized its wonderful properties. Further, we might say that like all operations which are indispensable, the means and appliances for its use have continually changed and improved.

What, then, is the aim of the fulling process? We would say that the aim of this process is to so entwine the fibers of the yarn that has been woven into the form of cloth that whereas they once lay loosely beside each other in the unfulled fabric, they may after fulling become more compact and uniform, presenting a firm, smooth and even surface for the after-processes of wet and dry finishing. The fiber must possess certain essential properties before it can possibly undergo this process. The most important of these is that known as the felting or fulling property, which is developed to its most perfect degree in fine merino wools. The nearer to the nature and properties of ordinary hair any grade of wool approaches, the less of this essential does it possess.

The three artificial means which are always necessary in the operation of fulling are heat, moisture and friction. Soap is used in fulling, because wool from its very nature cannot sustain the required friction without the aid of moisture. The machine which produces the friction, and retains the heat thus generated, and the soap which produces the moisture, are the three agents employed in the art of fulling as it is practiced the world over.

Fulling mills and machines, although of several different styles, are all applications of the same general principles. First, we find the old-fashioned fulling stocks or hammers. These we speak of as old-fashioned, not because they are out of date and useless, but simply for the reason that they have been superseded by more modern contrivances which do quicker and generally better work. But there are some styles of finish which cannot be obtained in any way except by the use of the stocks. There is a soft woolen fabric, much in vogue for the past few seasons, made in imitation of the Scotch cheviot, which can be finished in no other way. Three-quarters of an hour in the stocks with plenty of soap brings our goods out with a feel and a body which cannot be produced in the rotary fulling mill. We cannot say then that the stocks are entirely useless when we pronounce them old-fashioned.

The first decided improvement on this machine was the narrow rotary or German fulling mill. This mill was meant to full only one piece at a time, and is used to-day more for fulling heavy overcoatings and blanketings than for the finer grades of cloth.

Then, last of all, there is the improved broad rotary mill, which is made so that two, three or even four pieces may be fulled on the one roller at the same time. These are, indeed, a marked improvement on the machines above mentioned, and yet even the broad rotary possesses disadvantages which cannot be overlooked. One of these lies in the fact that owing to their size they but imperfectly retain the heat generated by the friction. This heat is an absolute essential to the success of the operation, and if lost in any way, must be supplied and maintained by outside means.

Now, when our piece with the selvedges sewed on together is ready for the fuller, it is run into the mill, and the two ends are carefully stitched across. Then it is well to allow the piece to run for a few minutes dry before applying the soap, and afterward the soap is poured on gradually and evenly over the whole length of the piece. The manner of applying the soap, and the amount of it used, are two important points to be noted in the successful operation. If too much soap is used, the cloth is apt to be clammy and disagreeable; if too little, then it will be spongy and imperfect; if more soap is applied in one part of the piece than in another, the fabric will full unevenly, and if the soap is too strong or too hot, this, along with the heat and friction of the mill, will seriously affect not only the color, but the life and durability of the fibers themselves.

As to the best means of soaping, the soaping machine doubtless takes the lead, but where such is not at the disposal of the fuller, an ordinary tin pail with half inch spout will answer every purpose. By this means a small gradual stream of the liquid soap can be slowly directed against the cloth, and even distribution at once effected. In the application of the soap all depends upon evenness in the distribution, and if this is not obtained, there will surely be unsatisfactory results in the finished cloth. As to the amount of soap necessary, it will be best to bear in mind two or three facts. The amount of felting the piece is to receive, the time required to full, and the kind of stock there is in the fabric, all have an important bearing upon this matter. Too little soap or short stock, or soap not rich enough for the friction and time required for fulling, will be sure to lead to unending trouble.

The goods will never begin to full until they become worn. But when the heat is once generated, then it is all important that it be kept as uniform as possible. If at all practicable, great fluctuations in the temperature of the mill must not be allowed. It is not possible, however, to give the exact standard at which the temperature of the mill should be kept. This would naturally vary with the kind of goods in hand. Experience is the best teacher. The idea of hanging a small thermometer inside the mill as a guide in keeping the temperature regular and sufficiently high is by no means a bad one, and may be practiced with success.

The troubles which come up in the fulling process and the means of overcoming them will be discussed in a later paper.—*Manufacturers' Gazette.*

Plants as Reagents.

From the results given it appears that by means of beer yeast it is possible to recognize the presence of 0·0005 grm. of phosphate in 1 liter of water, which corresponds to 5-10,000,000ths of the weight of the liquid. But agricultural plants are also reagents of an extreme delicacy and accuracy. The author gives as an example the sugar cane, the dominant food of which is calcium phosphate. With the complete manure the cane gives a harvest of 57,000 kilos. per hectare. If we omit the phosphate, the yield is only 15,000 kilos. Hence 600 kilos. superphosphate, containing 90 kilos. phosphoric acid, determine an excess of crop of 42,000 kilos. per hectare, which represents 70 times the weight of the phosphate and 466 times the weight of the phosphoric acid. If referred to the 4,000,000 kilos. of vegetable soil covering the surface of a hectare, the phosphate represents less than 1-6,000th part of the weight of the soil, and the phosphoric acid less than 1-40,000th. The author hopes to fix the limits of this method.—*Georges Ville.*

Remedy for Roaches.

Take three pounds of oatmeal, or meal of Indian corn, and mix it with a pound of white lead; moisten with treacle so as to form a good paste, and put a portion down at night in the infested building. Repeat for a few nights alternately, and in the morning remove the paste and the corpses to a convenient place.

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RECENT IMPROVEMENTS IN THE PNEUMATIC DYNAMITE GUN

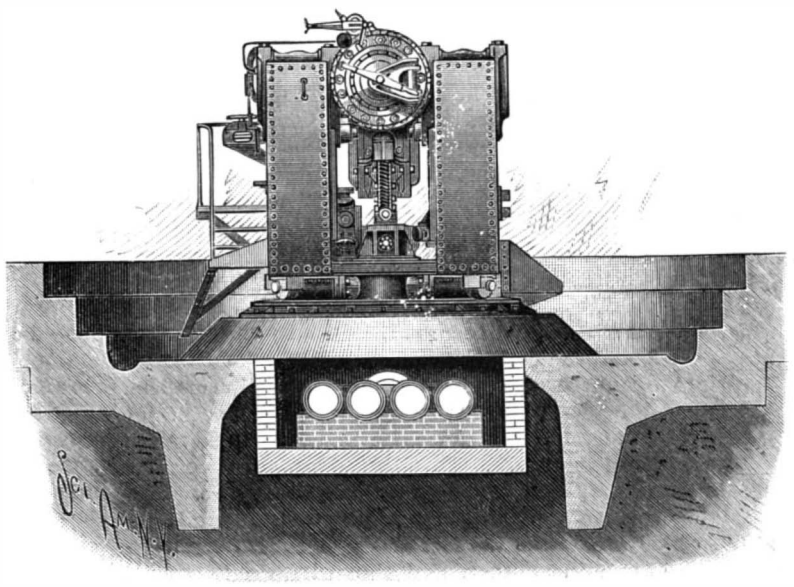
(*Continued from first page.*)

The loading and firing mechanism is arranged on the interlocking plan, so that the different operations must succeed each other in their regular order, thus not only insuring safety to the gun and its operators, but saving a great deal of valuable time.

The gun now appears complete in all its details. It is a fine example of mechanical engineering, which reflects credit on both the designer of the gun and its promoters. It is so well proportioned as to render it difficult to realize its true dimensions. Its length is fifty feet. Its total weight is forty tons. The total weight of the full caliber projectile is 1,000 pounds, the explosive charge alone weighing 500 pounds. The range of the gun at 35° elevation with the large projectile is 2,400 yards; with a ten inch subcaliber projectile weighing 500 lb. it is 4,400 yards; with an eight inch subcaliber projectile weighing 340 lb. the range is 5,000 yards; and with a six inch subcaliber projectile weighing 240 lb. the range is 6,000 yards. The weight of the explosive charges in the subcaliber projectiles named would be respectively 200 lb., 100 lb., and 50 lb.

The firing pressure is maintained in the reservoirs at 1,000 lb. per square inch. This pressure is kept up by a supply from storage reservoirs containing air under a pressure of 2,000 lb. per square inch. Up to the present time heavy wrought iron tubing has been used in the construction of the storage and firing reservoirs, but cast steel spherical reservoirs of six feet diameter are to be used in future in lieu of the tubes, thereby reducing the number of joints and the liability to leakage.

The gun herewith illustrated is one of six which have recently been built at the works of the West Point Foundry Company, at Cold Spring, N. Y., which have been sold by the Pneumatic Dynamite Gun Company to the English government.



DYNAMITE GUN, END ELEVATION, PARTLY IN SECTION.

Manufacture of Vermilion by Electrolysis.

In a wooden vat, one meter in diameter and two meters deep, circular plates 15 centimeters wide are placed against the sides, and on these the mercury is exposed, one centimeter deep. These plates are connected with the positive poles of a dynamo. At the bottom of the vat is a sheet of copper electro-plated with iron, and connected with the negative pole. The vat is filled with a solution of 8 per cent of nitrate of ammonia and 8 per cent of nitrate of soda. A worm, pierced with holes, supplies a constant and regulated current of sulphuric acid; the excess of gas escapes by a tube projecting from the lid. A screw agitator keeps up a thorough mixture in all parts of the liquid. When the current passes, it immediately forms a precipitate of red sulphide of mercury. Attempts have been made to dispense with the current of sulphuric acid by making up the bath with: Water, 100 liters; nitrate of ammonia, 8 kilos; nitrate of soda, 8 kilos; sulphide of soda, 8 kilos; sulphur, 8 kilos. Under these conditions one need only add sulphur and mercury to extract at the end of the operation vermilion which rivals that which can be obtained by sulphate of ammonia.

Local Interests Improved by Electricity.

Electricity is doing more for the country towns, says the *Pittsburg Dispatch*, that all other agencies combined. It is lighting villages that would otherwise be groping in the dark, for gas corporations do not settle in such places. The game is not big enough. But the greatest thing electricity is doing for the small towns is the running of the street cars. This has given them a forward impetus that has been of immense benefit to all of their business interests. A great deal of the vim and push seen in Western Pennsylvania towns is due to electricity.

The New Deep Water Pass at Corpus Christi.

Between Corpus Christi Bay and the Gulf of Mexico there is a narrow island, called Mustang Island, which is about twenty miles long. At the northern end of this island is Aransas Pass, separating it from St. Joseph's Island. This pass has 30 feet of water in its main channel, but there is only 8 feet over the bar, which limits the draught of vessels which can now go to Corpus Christi. At the southern end is Corpus Christi pass, now very shallow and of no importance.

It is a peculiarity of all the passes on the Gulf of Mexico that they tend to move to the southward, by cutting away the north end of the islands adjoining them and building up the south end. After they have worked themselves south of the bays for which nature had made them as an outlet, they choke up more and more until some great storm comes, which breaks out a deep pass again directly in front of the bay, where the pass had been once before. Then the new pass begins again its slow march to the south, history again repeating itself.

Aransas Pass, the present entrance to Corpus Christi, has thus been moving southward for years. To prevent its further progress, the government has been engaged in placing a stone revetment on the northern end of Mustang Island, but it is slow work, and after it is completed there remains the construction of a channel through the bay to Corpus Christi. The present channel, a narrow and tortuous one, extends around the east, north and west sides of Harbor Island.

Colonel Ropes, in studying the question of the movement of the passes, came to the conclusion that probably the time is not distant when nature would repeat herself and break out a new deep pass opposite the center of Corpus Christi Bay.

He resolved to anticipate nature, and cut the new pass himself. His engineers examined the ground and the bay carefully in order to locate the new pass where the old channel of the Corpus Christi pass once had been, and where, therefore, the deepest channel could in future be maintained. That spot was found directly opposite the deepest water in Corpus Christi Bay. It was also where the lowest points of land are found on Mustang Island, and also where deep water in the Gulf comes nearest the shore.

Work has been commenced on the new pass, to be called Ropes Pass, and a steam dredge has been at work cutting a channel through the island, night and day, for the past two months.

The distance across the Mustang Island at Ropes Pass is about two miles. It is intended to ultimately make the cut 1,000 feet wide, and to place a revetment upon the southern bank of it to prevent the bank moving southward. A jetty also is projected to be run out into the Gulf from one or both banks.

Mustang Island differs from most of the islands along the Gulf coast in being composed of high cliffs and banks reaching forty or fifty feet above the level of the Gulf. It is, therefore, high and dry above storm tides. Advantage is to be taken of this fact to locate the deep water docks in the pass itself, instead of at the city of Corpus Christi, twenty miles distant. A terminal railroad will be built from the city to the docks. At the point where it crosses from the mainland to the island the water in Laguna Madre, shown on the map, is only 1½ feet deep, so that the railroad presents no engineering difficulty.

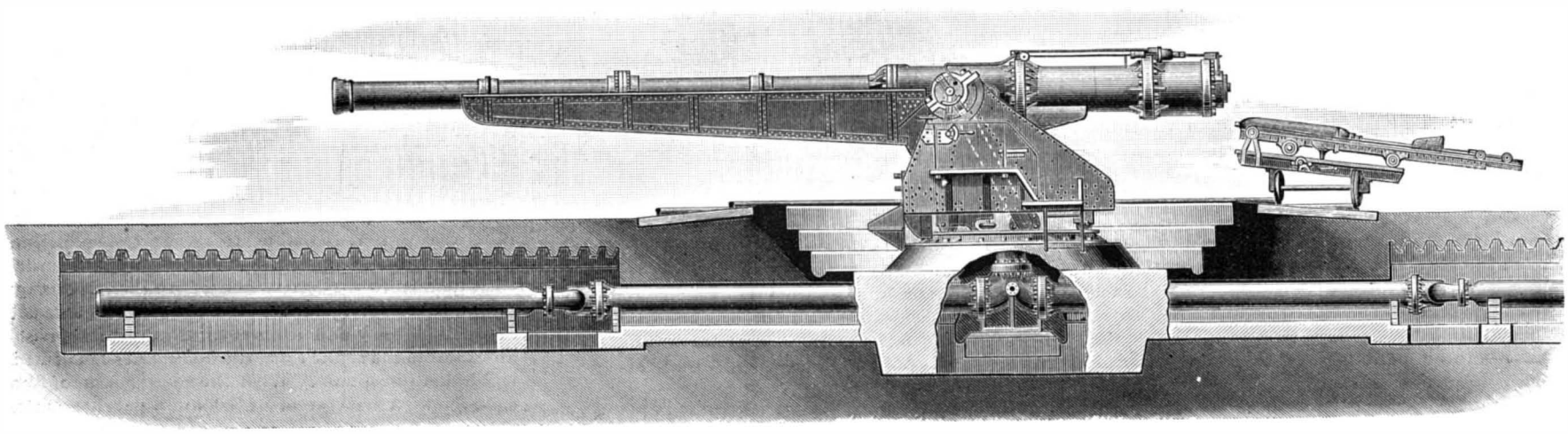
Corpus Christi is now the terminus of two railroads, the San Antonio & Aransas Pass, leading to the northwest, and the Mexican Central, leading westward to Laredo, and thence to the city of Mexico. It is the terminus also of the Corpus Christi & South America Railroad, which is now under construction from Corpus Christi to Brownsville, 150 miles due south on the Mexican border. Railroads are also projected westward to Eagle Pass, Texas, to connect with the Southern Pacific, and to Topolobampo, Mexico, on the Gulf of California.

When deep water is secured through Ropes Pass, and proper dock facilities are provided, these railroads will be connected by means of the terminal railroad with Port Ropes, which will then become an important seaport, Corpus Christi and "The Cliffs" adjoining it remaining as the most desirable places for residence and general business.

The boldness of the project of Col. Ropes in cutting through two miles of island, and neglecting Aransas Pass, will command the attention of all engineers interested in harbor improvements. Should he succeed in it, the future city of Port Ropes will be a grand monument to his sagacity and enterprise.—*Eng. and Min. Jour.*

Granite Composition.

A new composition is now made from finely crushed granite, and which when formed into shapes by moulding, and afterward burned and hardened, is to all appearances as hard and strong and durable as the solid stone itself, which it also closely resembles. It is claimed by those who have brought forward this process that all kinds of ornaments for architectural purposes, such as window caps or sills, cornices, freizes and all other articles of this nature, can be moulded to accurate shapes and forms, and manufactured by this process at one-tenth the cost of cutting the same out of solid rock. They can also be vitrified so that they take on a permanent gloss as fine as polished granite, and at a mere fraction of its cost. The composition follows closely the color and texture of the stone from which it is made, Roxbury granite making a light colored block, Quincy granite a darker one, and so on. The composition can be produced from waste stone, of course, as well as any, and the process is applicable to other stones as well as granite, the stone, of whatever description, being first crushed in a stone crusher, and afterward more finely powdered by passing between iron rollers. —*Manufacturers' Gazette.*



DYNAMITE GUN, SIDE ELEVATION, SHOWING LOADING CARRIAGE.[1]

Artificial Phenic Acid.

M. De Luynes presented recently to the Societe Nationale d'Encouragement pour l'Industrie, on behalf of M. Reines, specimens of synthetic phenic acid prepared at Neuville-sur-Saone at the branch works of the Baden Aniline Company. This acid is quite colorless; it melts at 41°, boils at 178°, and yields limpid solutions. Its slight odor differs from that of the purest phenols of commerce. On account of its properties and its low price it is likely to supersede ordinary phenol in its applications to medicine, to the preservation of putrescible articles, and in the manufacture of chemical products.

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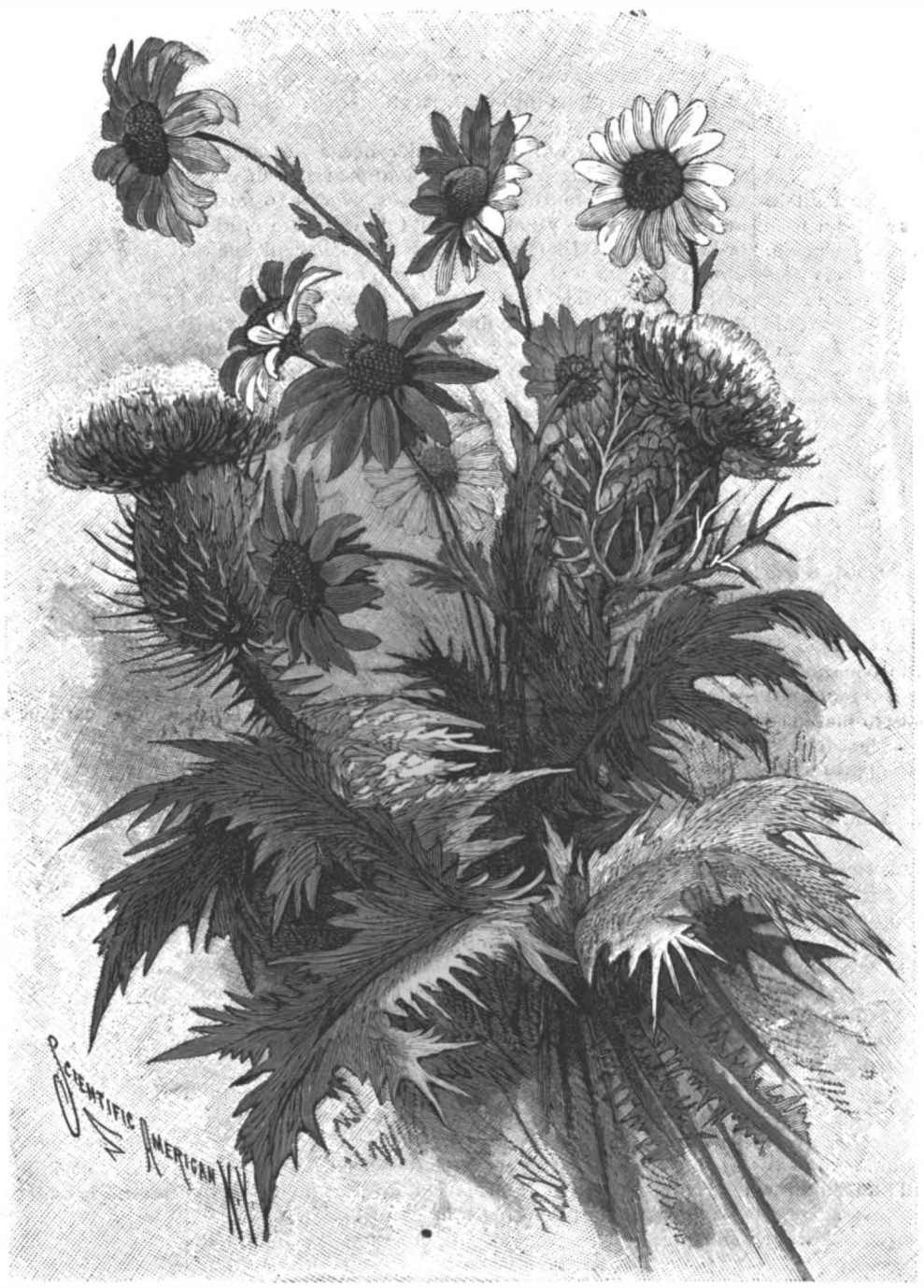
DAISIES AND THISTLES PROSCRIBED BY LAW.

To an admirer of the fine descriptions of daisies which have been the result of their cultivation, it seems difficult to appreciate that they are only varieties of the too common whiteweed filling so many meadows and pastures throughout most of the Northern States, very difficult to eradicate, extremely wasteful of the land, and a great pest of the farmer. Yet such is so certainly the fact that both white and yellow daisies have been prohibited by law in at least two of the States—New York and Wisconsin—and in Canada, being placed on a par with the thistle as noxious and mischievous weeds. The New York statute says that both daisies and thistles shall be cut down twice a year along the lines of all canals and railroads, and on lands bordering the public highways, in June and July and in August and September, and in certain cases they may be cut down by any one at the expense of any corporation on whose lands they are found.

Our illustration represents varieties of the white and yellow daisy and of the common and Canada thistle. The daisies shown are larger and somewhat different from those bearing the cut-toothed and slightly pinnatifid leaves below and the naked summit with the showy head, which are the most commonly found throughout the country; but they are all of the same family, the size and luxuriance of the plant being much affected by the nature of the soil in which it grows. In many of the fields in the vicinity of New York and throughout the States of New York and New Jersey the grass will often be white or yellow, as the case may be, with these daisies, which means the great injury of any crop sought to be raised on such ground. They are not eaten by any kind of stock, and cattle avoid hay in which they are found, while they propagate themselves so rapidly that it is very difficult to eradicate them. One of the most highly recommended among insect powders recently introduced, commonly known as buhach, is made from pyrethrum, which is only a name of one of the varieties of the daisy.

Of the thistle there are about thirty species found in the United States, the two kinds shown being found almost everywhere, and being the most annoying of weeds. The common species, often called the bull thistle, has large leaves with their bases prolonged downward upon the stem as a spiny, lobed wing, prickly on the upper surface and having cobwebby hairs below. In rich soil its stems grow to three or four feet high, and present a very formidable appearance, though in reality it is easily destroyed. The Canada or perennial thistle is the Scotch national emblem, and is known in Europe as the creeping thistle. It spreads rapidly and extensively by its long creeping rootstocks, sending to the surface numerous stems, two to three feet high. The handsomely cut leaves are smooth or slightly woolly below, and very prickly on the margin, with slender spines. The male heads have more conspicuous flowers than the female heads. This plant has long been regarded as one of the worst pests of farmers, its deep roots, below the reach of the plow, and its abundant seeds, furnishing it with ample means for spreading, although, like other perennial weeds, it yields to frequent and persistent mowing.



DAISIES AND THISTLES.

A Dynamite Shell Bursts a Twelve Ton Gun.

Dr. Justin, of Syracuse, N. Y., made a third unsuccessful attempt to fire a dynamite shell of his construction, by the use of a powder firing charge, on August 26. The gun was a twelve foot rifled barrel, with a nine inch bore, and weighed twelve tons. It had been previously tested with forty-five pounds of cannon powder behind a shell weighing 375 pounds. One shell weighing 295 pounds, and said to contain fourteen and a quarter pounds of dynamite, was fired with entire success, thirty pounds of powder being used to project it, but on a second attempt being made, with a similar shell and charge, the gun was blown to pieces, which were scattered over a wide area, a number of the spectators narrowly escaping. Dr. Justin's shell has an inner brass magazine holding the dynamite, inclosed within a shell of steel, there being an air space between them.

Natural History Notes.

Ornithophilous Flowers.—Mr. G. F. Scott-Elliot, in papers recently contributed to the *Annals of Botany*, gives some interesting particulars regarding the pollination of flowers by the agency of birds, chiefly in South Africa. The birds that are most effective for this purpose are the sun birds (*Cinnyridæ*), the species which were observed most frequently to visit flowers being *Nectarinia chalybea* and *bicollaris* and *Promerops caper*. Those birds have the same habit as the honey bees and Bombydæ of not mixing their honey, that is to say, on the same flight they confine their visits entirely, or nearly so, to the same species of flowers—a habit obviously of the greatest importance in securing the pollination of the stigma by pollen from another flower of the same kind. The majority of the ornithophilous flowers of South Africa are colored exactly the same (of an unusual shade of red) as the breasts of the species of *Cinnyris*, a fact previously noticed by both Darwin and Wallace.

Dimorphic Females of Butterflies.—*Insect Life* says: It is a well known fact that in certain Diurnal Lepidoptera the male sex is constant in coloration while the female appears in two forms, one being similar in coloration to the male, the other considerably different therefrom. An instance of this class is our *Papilio turnus*. In other cases of female dimorphism the form resembling the male is wanting, as is the case in our *Argynnis Diana*. Mr. Charles Oberthur now advances the question (*Ann. Soc. Ent. France*, 1889, *Bull.*, p. ccxxxv) whether in this latter case the form corresponding in coloration with the male should not always exist. He believes that in these polymorphic species the original form of female was of the same coloration as the male, and the aberrant form developed subsequently and gradually. As a proof of this hypothesis he communicates an interesting recent discovery. *Argynnis niphe* is an old and common species enjoying a remarkably extended range, since it occurs in Abyssinia, India, China, on the Philippine Islands, and Java. From all these widely distant localities the female of this species was hitherto known only in a form strikingly different from the male. Quite recently, however, Mr. Oberthur received from a place in southern Hindostan bearing the attractive name of Trichinopolis specimens which prove that in this particular locality the female of *A. niphe* differs no more from the male than in most other species of *Argynnis*. Does Mr. Oberthur's hypothesis hold true in all cases, and should we really expect to find in our *A. diana* females which correspond in coloration with the male?

The Moulting of Spiders.—When a spider is preparing to moult, it stops eating for several days, and fastens itself by a short line of web to one of the main lines of its snare, which holds it firmly while it proceeds to undress. The skin cracks all around the thorax, and is held only by the front edges. Next the abdomen is uncovered. Now comes the struggle to free the legs. It works and kicks vigorously, and seems to have very hard work. But continued perseverance for about fifteen minutes brings it out of the old dress, and it seems almost lifeless, and is limp and helpless for several minutes, but gradually comes back to life, and looks brighter and prettier than before.

Parthenogenesis in the Fig.—Dr. D. D. Cunningham, of the Indian medical service, has published a remarkable treatise on the production of the fruit of *Ficus Roxburghii*, Wall. The species is dicœcious. The male receptacles or figs contain perfect male flowers with pollen, together with atrophied or imperfect female or "gall flowers," which never produce seed. Within the ovary of these gall flowers an insect, usually a species of *Eupristis*, lays its eggs, and there they develop into perfect insects. The female figs contain perfect female flowers, producing fertile seeds, the insect never laying its eggs in their ovary. The ostiole, or opening, of both the male and female figs is so obstructed by a covering of bracts that the receptacle is an almost completely closed chamber. The perfect development of both the male and female flowers is, however, dependent on the access of the "fig insect" to the interior of the cavity, without which neither of them would attain a functional condition. But, although the development of the embryo in the female figs is essentially connected with this access of insects, Dr. Cunningham believes that it is not brought about by the introduction of pollen through their agency.

The almost entire closure of the ostiole by bracts presents a nearly insuperable obstacle to the introduction into the female figs of a quantity of pollen sufficiently large to impregnate every one of the exceedingly numerous ovules by a separate pollen grain; and he was able to detect but very few pollen grains within the female figs. Although it is possible that in some instances normal pollination may occur, Dr. Cunningham asserts that the embryo is ordinarily formed without any act of fertilization, and that it arises as an outgrowth of the parenchyme of the mucellus outside the embryo sac. Up to the period of the access of the insects, and of the initial development of the embryo, the embryo sac retains the character of a simple uninucleate cell, with no oosphere, synergidæ, or antipodal vesicles. The full development of both male and female flowers appears to be dependent simply on hypertrophy of the tissues of the receptacle, resulting from stimulation caused by the visits of the fig insects. This stimulation is brought about in the male figs by the insect laying its eggs within the ovary of the gall flowers. In the female flowers they attempt persistently to do the same, but these attempts are frustrated by the much greater strength and thickness of the ovary wall, and a similar stimulation is the result. The treatise is illustrated by five fine folio plates.

Destruction of the Kangaroo.—This interesting race is on the point of disappearing, and, according to the opinion of men capable of judging, there will soon be no longer a single kangaroo in existence if a stop is not put to the indiscriminate slaughter of the animals. Mr. R. G. Salomon, one of the most extensive of American tanners, and one of the principal importers of kangaroo skins, proposes that any one who kills a kangaroo whose skin weighs less than ten or twelve pounds shall be punished severely. Severe measures have already been taken in Australia and Tasmania, and it is forbidden in these countries to kill the animal between the 1st of January and the 1st of May.

To infringe a patent it is not necessary that the thing patented should be adopted in every particular. If the patent is adopted substantially by the defendants, they are guilty of infringement.

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[SAW-MILL GAZETTE.]

How to Manage a Steam Engine.

A PRIZE ARTICLE.

BY ECCENTRIC ROD.

We will assume that a man is wanted to take charge of an engine and boiler, and I am the lucky applicant. The boiler in question is the horizontal type, set in brickwork, fire under shell and return through tubes to chimney; size, say forty-two inches diameter of shell, twelve feet long. The engine is a common horizontal, plain slide valve, size twelve by twenty. Before doing anything in the way of work, I would make careful examination of boiler. I would test the try-cocks, see that they are all free to work, also the glass water gauge. Then I would open the flue door and notice how high above the top row of tubes the lowest try-cock is. This will be of value, as the boiler feed might bother some time, and I would know how low I could carry water and be safe. If I were to place the try-cocks, I would have four inches of water between the tubes and the lowest try-cock. I would also examine the safety valve and see that it worked freely. If it is a leaky valve, I would expect to find a bucketful of stone or iron, also one or two iron pulleys, and all the spare wrenches hanging on the lever. I have seen just what I have mentioned; rather than grind in the valve tightly, all the safety is taken away from the valve by jamming it down with heavy weights. I would find the blow-off, and by all means I would see what I had for a boiler supply.

I find it rather hard to examine a boiler, with all its valves and connections and joints, if it has been used some time, unless some steam is raised. An inspector gets his points from the man in charge, and this renders his task much easier. The very first chance I got I would examine the inside of the boiler. I would open the manhole (on the top of the boiler usually) and take out the hand plates; one can be found by opening the flue door at the front. Some boilers have a plate at the back also. With a light hammer and candle I would go inside the boiler to examine it. I would look for broken and loose stays; these run from the head above the tubes, diagonally to shell. I would see that the pins holding their ends were all in place, and by hitting them with a hammer I could tell by the sound if any were broken. I would notice how much dirt and scale were on the tubes, and then I would know what I had to do. I would close up the boiler again, bearing in mind that the first opportunity would find me cleaning the boiler. If I find the packing on the hand plate has been torn by being taken out, I cut new, from three-ply rubber, and by putting black lead or stove polish on the part of the rubber that comes against the boiler, cause it to adhere to the plate without sticking, so the joint can be broken many times and still tighten again when replaced. I have used this packing two years.

If I find the glass in the gauge broken, I would take off the nuts on the stuffing box, thoroughly cleaning the latter, and I would use candle wicking for packing instead of the rubber rings usually sent with glasses. The rubber, by warmth, is apt to be sticky, and should a leak be seen, it sometimes bothers the engineer to tighten the joints. With wicking you can tighten them any time, but I never touch them when steam is on, neither do I leave the valves connected with the glass wide open. One turn on each is sufficient, and should the glass break you can quickly shut off steam and water. I would watch the water in the glass, and if it is dancing and always in motion, I would know it was in good working order, but when still and sluggish at times, I would know that there is a stoppage somewhere. I prefer to have each try-cock on its separate pipe, and the glass gauge to have no other connection than the boiler, then each pipe tells its own story. I can keep a glass clean for months by blowing out dirt from the inside and by washing outside with cloth. When steam is down, I never let any metal touch the glass, as the least abrasion will cause a break.

I want the steam gauge put on so that the pipe leading to it will have water in it near gauge. This prevents steam from springing in the gauge and destroying it. I want a cock close to the gauge to drain the pipe, so that I will know it is free from dirt, and that the opening into the gauge is clear. I would set the ball on the lever to safety valve to blow say at sixty pounds by gauge, and I would make it work within five pounds. It can be done by having the valve tight and by oiling all the joints and keeping them clean. The ball and lever are commonly used, and I prefer them to any other kind for stationary boilers.

On steamboat or road engines the pull would be hard to keep in any one place, so a spring is preferable. I would open the safety valve every day to insure easy working, but I would raise slowly, as a sudden lift, opening wide, would relieve pressure over the water, and would be apt to lift the water, and that carried to the engine might do damage.

I have put in a number of surface blow-offs, and I think they help to keep a boiler clean more than any one thing. The position, for height, would be between the first and second try-cock, counting the top first.

I put a one inch pipe through front of the boiler head, and let the pipe screw through far enough, so that by getting inside I can put on another piece that runs nearly the whole length of boiler, and in this I put a row of one-quarter inch holes. Now, the first one I tried I blew off against a wooden building, and it was covered with mud, so I was satisfied that a great part of the sediment goes to the surface of the water and stays there as long as boiling continues, and then is the time to use the surface blow. I use just before noon and before quitting time. After boiling ceases, the sediment settles and all will not rise; some will stick to the shell and tubes. I open the blow-off once or twice a week, and blow down about one gauge. I never empty the boiler under pressure, as the furnace and bricks are hot as well as the iron in the boiler, and the heat will bake mud on the iron. I wait until Sunday morning, and then run out; water and the mud will wash out easily. I speak of Sunday, as the night is a bad time to work, and usually a boiler is worked six days, leaving Sunday as the only time for cleaning. I will not use a globe valve for a blow-off, for if any scale should get under the valve, it would not screw down tight. I had one once, and I was in trouble. One day some scale got under and it leaked all day. I drove a plug in the pipe beyond the valve, but that did not work very well. I use a plug cock, and if any dirt gets into that, it will get cut into when turned.

I can generally tell when a boiler needs cleaning by water from the try-cock and the appearance of glass gauge. I change the water about every two weeks, and clean out every four, unless I have to use muddy or hard water. In cleaning out I use a small hoe to draw dirt (that will not wash out) up to the hand hole, and I take particular care not to leave any over the fire on shell. I saw a boiler badly burned by leaving a little pile of dirt not larger than my hat crown. There are many compounds to prevent scale, but my device is a feed water heater that will boil the water sufficiently to separate all impurities and run through filter; then none can get to the boiler, but with the common heater constant cleaning is the best remedy I have found. When the boiler begins to steam hard I look at the tubes, as they are proverbially dirty. A metal scraper is the best of anything I have used, and particularly so if wood is burned. I have used in coal burning, after cleaning tubes, zinc scraps in fire; it makes a coating that prevents dirt from sticking so badly. I like to have feed go in the front head, and blow-off the back end; this has a tendency to establish a current that will carry dirt away from the fire. I like the feed about six inches from bottom. Some object to feeding in at the fire end, but if the water is heated before going to the boiler, I have never seen any bad results from heated water.

(To be continued.)

Portland Cement for Anchoring Bolts.

A writer in the *Polytechnic*, of Troy, relates how, during a recent experience in constructing foundations for an elevated railway, solid rock was encountered so near the surface as to necessitate anchoring the foundation bolts in it. Some more durable and economic means of accomplishing this than by the use of sulphur or lead was desired, and Portland cement was suggested as being suitable.

A careful investigation failed to find any record showing the adhesive strength of cement in pounds per square inch when used this way. Hence it was decided to make such experimental tests as would give reasonably positive information on this point. For this purpose fourteen holes were drilled in a ledge of solid limestone, seven of them being 1⅜ inches in diameter and seven of them 1⅝ inches in diameter, all being 3½ feet deep. Seven ¾ inch and seven 1 inch bolts were prepared with thread and nut on one end and plain at the other end, but ragged for a length of 3½ feet from the blank end.

Four were anchored with sulphur, four with lead, and six with cement mixed neat. Half of each were ¾ inch and half 1 inch bolts, and all of them were allowed to stand till the cement was two weeks old. At the expiration of this time a lever of sufficient power was rigged, and all the bolts were pulled, with the following results:

Sulphur.—Three bolts out of four developed their full strength, 16,000 and 31,000 pounds. One 1 inch bolt failed by drawing out under 12,000 pounds.

Lead.—Three bolts out of four developed their full strength, as above; one 1 inch bolt pulled out under 13,000 pounds.

Cement.—Five of the bolts out of six broke without pulling out; one 1 inch bolt began to yield in the cement at 26,000 pounds, but sustained the load a few seconds before it broke.

While this experiment demonstrated the superiority of cement both as to strength and ease of application, yet it did not give the strength per square inch of area. To determine this, four specimens of limestone were prepared, each 10 inches wide, 18 inches long, and 12 inches thick, two of them having 1¼ inch holes and two of them 2¾ inch holes drilled in them. Into the small holes 1 inch bolts were cemented, one of them being perfectly plain round iron and the other having a thread cut on the portion which was embedded in the cement. Into the 2¾ inch holes were cemented 2 inch bolts similarly treated, and the four specimens were allowed to stand thirteen days before completing the experiment. At the end of this time they were put into the standard testing machine and pulled. The plain 1 inch bolt began to yield at 20,000 pounds, and the threaded one at 21,000 pounds. The 2 inch plain bolt began to yield at 34,000 pounds, and the threaded one at 32,000 pounds, the strain in all cases being very slowly applied. The pump was then run at a greater speed, and the stones holding the 2 inch bolts split at 67,000 pounds in the case of the smooth one, and at 50,000 pounds in the case of the threaded one.

It is thus seen that cement is more reliable, stronger and easier of application than either lead or sulphur, and that its resistance is from 400 to 500 pounds per square inch of surface exposed. It is also a well ascertained fact that it preserves iron rather than corrodes it. The cement used throughout the experiment was an English Portland cement.

Number and Tonnage of all Seagoing Sailing and Steam Vessels for all Countries of the World in the Year 1889.

	Sailing Vessels.		Steam Vessels.	
	Number of Vessels.	Tonnage.	Number of Vessels.	Tonnage.
Great Britain (United Kingdom)	3,593	2,467,212	5,574	7,774,644
Colonies	2,075	894,040	829	461,210
	5,668	3,361,252	6,403	8,235,854
Norway	2,974	1,337,686	395	246,669
United States of America	2,856	1,306,488	416	517,394
Germany	1,135	640,400	741	928,911
Italy	1,343	515,942	212	300,625
Sweden	999	294,183	471	181,781
Russia	945	271,265	236	156,070
France	854	235,504	526	809,598
Greece	879	223,801	92	83,839
Netherlands	382	161,762	162	217,022
Turkey	813	158,170	94	71,607
Denmark	591	120,993	217	159,072
Spain	494	119,994	389	414,817
Austria	238	118,482	130	151,166
Brazil	385	81,359	121	67,707
Chili	123	71,457	29	30,934
Portugal	173	46,501	43	44,701
Japan	124	33,123	165	138,431
Argentine	70	21,897	56	21,245
Peru	35	8,860	2	2,188
Hawaii	10	5,567	17	13,838
Belgium	8	4,104	77	106,467
Siam	7	3,519	3	644
Mexico	16	3,308	16	7,733
Montenegro	17	3,282	—	—
Uruguay	11	2,903	20	9,111
Bolivia	3	2,302	—	—
China	7	1,282	34	44,558
Venezuela	7	1,123	6	2,635
Hayti	5	989	8	3,401
Colombia	2	444	—	—
Roumania	2	407	3	529
Sarawak	1	347	6	2,269
Costa Rica	1	288	2	528
Persia	—	—	1	838
Zanzibar	—	—	6	4,723
Other countries	12	7,295	9	8,467
Total	21,190	9,166,279	11,108	12,985,372

—Lloyd's Register.

Building in 1889.

The money actually expended annually in the erection of new buildings in the United States can scarcely be realized by those who give no attention to the business. The following table, compiled by the *Weekly Record*, is an interesting schedule of what was done in 1889:

Cities.	No.	Cost.
Baltimore	1,955	$3,600,000
Boston	4,431	32,400,000
Brooklyn	*4,500	25,679,405
Charleston	225	294,575
Chicago	4,931	25,065,500
Cincinnati	2,104	4,143,214
Cleveland	4,007	4,401,854
Denver	2,741	10,807,377
Duluth	240	2,480,800
Indianapolis	1,800	4,500,000
Jersey City	930	2,930,857
Louisville	992	1,746,383
Milwaukee	1,624	4,610,000
Minneapolis	4,355	8,737,281
Newark	1,541	†5,000,000
New Haven	628	2,066,700
New Orleans	1,061	1,465,105
New York	6,722	75,912,816
Omaha	2,498	4,663,735
Philadelphia	11,965	26,000,000
Pittsburg	3,241	†8,000,000
St. Joseph	1,181	1,413,067
St. Louis	3,544	9,765,700
St. Paul	3,756	7,939,493
Toledo	300	1,500,000
Washington	4,048	6,165,715
Wilmington	522	866,980

* Number estimated; cost actual.
† Estimated.

This gives a total for twenty-seven cities of 75,842 buildings, costing $382,155,557, being an increase over the preceding year of 9,721 buildings and $42,749,628 cost.

These figures give an approximate idea of the rate at which the country is growing, and perhaps no more conclusive evidence can be found of our industrial progress and national stability than in the above statistics.

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THE NEW GERMAN ARMORED WAR SHIP SIEGFRIED.

The armored vessel Siegfried, which was added to the service, on trial, this year, represents a new type of vessel in the German navy, which is thereby improved from a defensive as well as an offensive point of view. As it is well armed, it can successfully face hostile armored vessels on the high seas, especially as it is thoroughly seaworthy. Its external form is very peculiar, differing entirely from other German war ships. Its breadth and the shape of its sides give it the appearance of a gigantic fish. The bow runs out like a ram's horn, while the stern is perpendicular, and under the water the stern is drawn in so that the rail projects over the rudder. On account of the small draught, the bottom of the vessel is broad and flat, and to increase its stability strong side keels are provided.

The Siegfried is about 239 ft. long, 46 ft. wide, and draws 17 ft. of water. Its displacement is 3,400 tons. The 4,800 H. P. engines operate two three-bladed screws, and give the vessel a speed of 16 miles per hour. The armor extends on the water line throughout the entire length of the ship. There are three guns of large caliber (long 28 centimeter cannon), two of which are placed at the bow and one in the stern, in armored turrets. The vessel is further provided with revolvers and quick-firing guns, besides two torpedo-throwing devices. The Siegfried was built at Kiel, and was launched August 10, 1889. The cost of construction, not including the armament, was $840,000. The builders will profit by the experiences of the trial trip of the Siegfried in building other vessels of the same class, two of which were begun last year.—*Ueber Land und Meer.*

War Ships of the World.

Mere figures can never adequately represent the comparative strengths of navies, there being, says *Engineering*, so many details affecting efficiency in action. The following figures, however, may be interesting:

	Britain.	United States.	France.	Germany.	Italy.	Russia.
Number of first-class armor-clads (18 in. armor and above)..	19	.	13	..	10	7
Other sea-going armor clads	41	..	27	16	11	17
Cruisers and sloops (above 900 tons)....	166	47	63	35	22	32
Gun vessels (over 600 tons)....	47	3	11	4	17	4
Gun boats (over 200 tons).....	81	2	37	10	22	14
War vessels over 14 knots	169	19	75	44	55	28
Merchant ships to each cruiser or sloop	39	9	8	21	10	7
Merchant tonnage to each cruiser or sloop	49,000	11,000	13,000	26,500	13,600	5,000
Merchant ships to each war vessel ...	38	22	7	17	4	8

The relative extent of coast line to defend also forms an element in the comparative strength of the fleets, and here again Britain shows a deficiency, owing to the widespread character of the empire. Speed is of strategic importance, and one or two figures on this score may be given:

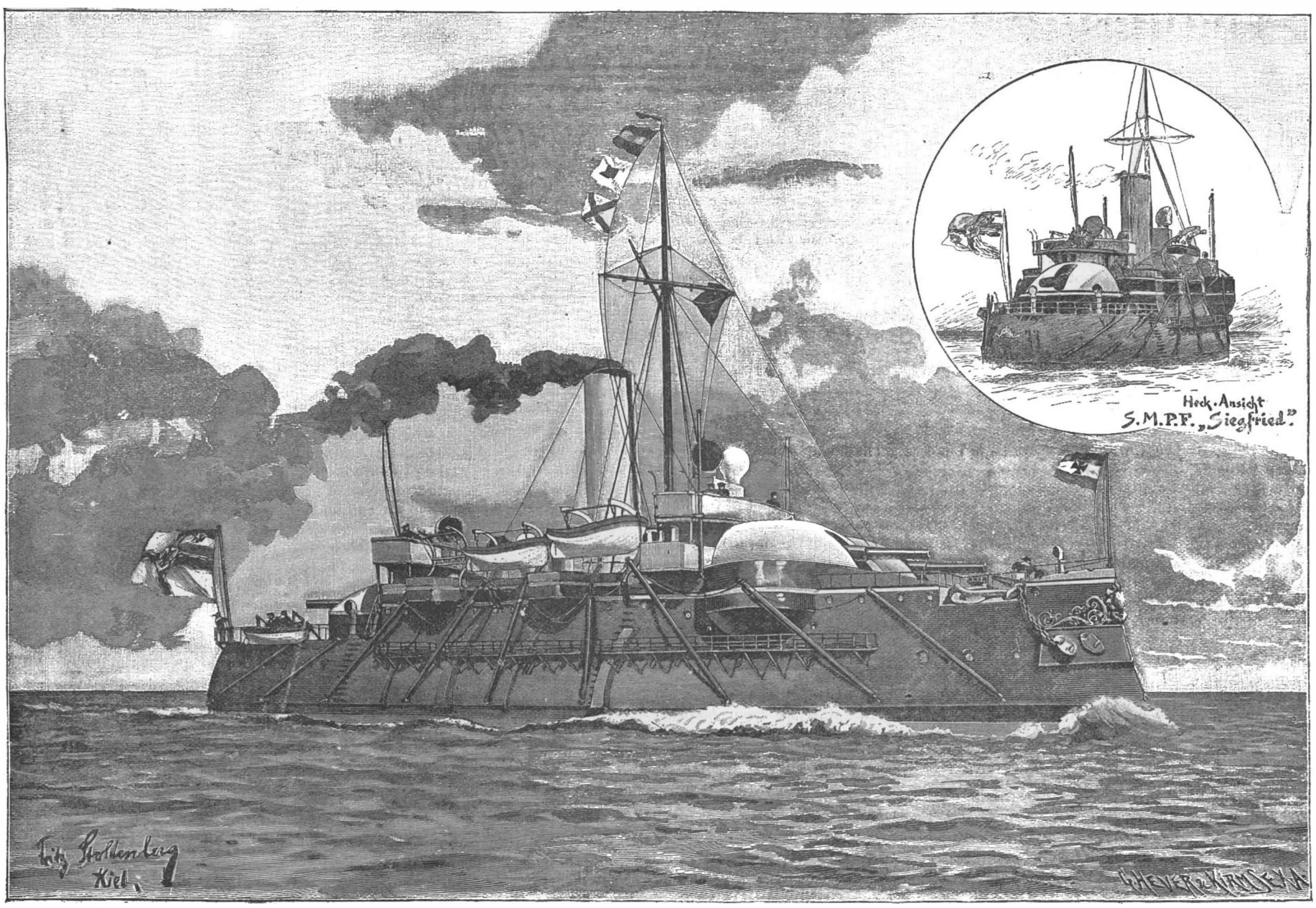
	Britain.	France.	Germany.	Italy.	Total including other nations.
Over 20 knots:					
Number.....	50	5	2	17	94
Tons displacement.....	135.900	24.280	640	12,390	238,663
Number of guns.....	290	48	..	16	350
Over 19 knots:					
Number	24	10	9	3	61
Tons displacement.....	96,510	30.030	10,870	7,900	208.210
Tons	196	58	10	26	375
Over 18 knots:					
Number..... ...	9	11	8	9	61
Tons displacement.....	46,660	4,980	57,260	71,310	232,800
Tons	107	5	56	72	364

The largest vessels included in the British total of 20 knot ships are the Blake and Blenheim, of 9,000 tons and 22 knots speed, with 9¼ inch guns. France's largest will be the cruisers Dupuy de Lome and Amiral Jaures, 6,300 tons and 20 knots speed. The latter two vessels are being built at Brest and Rochefort respectively. Germany has two small torpedo catchers of 22 knots, and Italy several of 21 knots speed, while Austria has three of 23 knots speed. Spain is building several large cruisers of 20 knots speed, and has the Reina Regente of 21 knots speed, and two sister ships incomplete. It seems only natural to state in this connection that sixteen merchant vessels are given as able to steam at a speed of over 19 knots, several of them at 21 knots, and others are forthcoming. Of this number nine are Atlantic vessels, three Hamburg-American liners, two White Star, two Inman, and two Cunard liners.

Natural Gas in California.

The *Pacific Lumberman* says an enormous flow of natural gas was recently struck at Summerland, a suburb of Santa Barbara. Three months ago a two-inch well put down for sulphur water struck a strong flow of gas, which has since been used for lighting and domestic purposes in Summerland. About three weeks ago a syndicate of Santa Barbara and San Luis Obispo capitalists leased the property, and commenced to put down a ten inch pipe. Gas in considerable quantities was struck at twenty-eight and thirty-four feet, and at a depth of forty-nine feet they struck a gusher. The noise was so great that it could be heard for blocks, and the flow could not be capped. It is estimated that the daily flow is at least 3,000,000 feet, exceeding any well west of the Mississippi river.

The syndicate proposes to pipe the gas at once to Santa Barbara, and it will offer special inducements to manufacturers. Already propositions have been received for the establishment of manufacturing industries.



THE NEW GERMAN ARMORED WAR SHIP SIEGFRIED—DRAWN BY FRITZ STOLTENBERG.

The Amount of Produce a Well Managed Garden is Capable of Yielding.

THE Boston *Transcript* says: "The amount of produce a well managed garden is capable of yielding is well shown by the following statement recently made by G. W. Hallock & Son concerning their fifty-eight acres of land near Greenpoint, Long Island, during last year: 3,750 bushels of onions and 4,500 bushels of carrots; early cabbages, 5,500 barrels; early potatoes, 2,500 bushels; strawberries, 11,000 quarts; onions from sets, 2,260 bushels; white beans, 160 bushels; carrots, 11,000 bushels; late potatoes, 450 bushels; onions from seed, 3,900 bushels; ears of corn, 2,000 bushels; Brussels sprouts, 500 bushels; potato onion sets, 10 bushels; carrot seed, 40 pounds; onion seed, 100 pounds; Brussels sprout seed, 4 pounds; cabbage seed, 2 pounds; Hungarian grass, 3 tons; cabbage plants to carry over, 250,000."

Sure Death to Borers.

Do not hunt for borers at all, says the *N. E. Homestead*, but just doctor them a little. Make a mixture of about one quart of wood ashes to a pail of water, and stir it well. Next make a ridge of earth around the tree a few inches from it, and high enough so when you pour your mixture into the circle it will run into the holes and kill the worms. It is sure death to them, and costs less than one cent a tree. I have used it for years, says the writer, with perfect success. You may have to do it twice the first year, but after that a very little care will keep your trees free from them. If you have no wood ashes, use a thin whitewash of lime in its place. If you have a large number of trees, you can use strips of zinc or sheet iron about four or five inches wide and long enough to put about the tree in place of the circle of earth.

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PHOTOGRAPHIC NOTES.

Timing the Duration of Flash Lights.—Professor Eder has made some interesting experiments, together with Captain Von Reisinger, for the purpose of timing the duration of the flash produced by various modes of burning the flash powder. He employed a heavy wheel of black wood of about twenty-six inches diameter, which is caused to revolve around its axis by hand. At the center of the wheel a silvered hemisphere of glass was attached, and a similar one at the circumference of the wheel. The latter was caused to revolve at the rate of one revolution a second. At first the image reflected by the hemispheres was focused by means of a candle light, then the room was darkened, the sensitive plate inserted, the lens uncovered, the wheel caused to revolve, and the flash produced. The plate was then developed, and showed a sharp point at the center of the wheel, and a sharp black line extending partly round the circle made by the rim of the wheel. This was the reflected light of the flash, and showed the arc through which the wheel had turned while the flash was produced. If this arc amounts to one-fourth of the circumference, the duration of the exposure has been ¼ second. The results of the experiments are as follows:

Explosive magnesium mixture, 30 parts of perchlorate of potash, 30 parts of chlorate of potash, 40 parts of magnesium powder containing 8 grains of magnesium	1/20 to 1/30 second.
Pure magnesium powder, blown as fast as possible through a glass tube into a spirit flame by means of an India rubber tube held in the mouth, containing 8 grains of magnesium	1/8 second.
Pure magnesium powder, burnt in Mr. Von Loehr's flash lamp, 8 grains of magnesium	1/4 second.
Pure magnesium powder, burnt by means of Dr. Hesekiel's flash lamp, 4 grains of magnesium	1/13 second.
Pure magnesium powder, burnt in Professor Schirm's flash lamp, 4 grains of magnesium	1/7 second.

These experiments show that the charges of magnesium powder mixed with chlorate of potash (the so-called explosive mixtures) are much quicker in combustion than those of pure magnesium powder alone. To those operators who have experience in flash light photography this result will not be surprising, but it is well known that the various flash light mixtures in which the magnesium is kept stored in mixture with potassium chlorate, picric acid, or other compounds acting as supporters of combustion, have occasioned serious accidents, so that it is doubtful whether their use is to be recommended generally.—*Mr. H. E. Gunther, in Photo. News.*

A Simple Printing Frame.—*Photographisches Wochenblatt* gives the following directions for making a cheap printing frame, viz., take any old or spoiled glass negative of the proper size, and cut it in two, then paste a strong piece of black muslin over both pieces. When thoroughly dry, this will form a hinge. For use, place the sensitive paper on the negative to be copied in the usual manner, then a piece of blotting paper, after which lay the cut negative, muslin side up, on the paper, and secure the whole with four spring clips or clothes pins, and print in the usual manner.

Over Eighty-one Miles an Hour.

A correspondent of *Engineering* says: Recently, when returning from Edinburgh by the West Coast route, I recorded no less than 6 miles averaging 80 miles an hour. Three miles down Shap were run in exactly 2 minutes 15 seconds, and three more down Grayrigg in precisely the same time. The engine was of the President type, 6 feet 6 inches, coupled drivers, cylinders 17 inches by 24 inches, and the load about ten coaches, or say 120 tons. The line falls 1 in 75 for about 4 miles from Shap Summit, then another 1½ to 2 miles at about 1 in 130, after which there is a rise to Grayrigg Summit, 26½ miles from Lancaster, where begins a fall of about 1 in 120, continuing for 14 or 15 miles. The following are the times as recorded:

Miles from Lancaster.	M. S.	Speed.
37½ Shap Summit (pass)	0 0	..
37	0 33	....
36	1 30	....
35	2 18	75·0
34	3 3	80·0
33	3 47	81·8
32	4 33	78·26
31	5 21	75·0
Slack at Lowgill, apparently for alterations in line.		
23	14 19	....
22	15 8	73·4
21	15 57	73·4
20	16 45	75.0
19		
18	18 17	78 26
17	19 1	81.8
16	19 46	80·0
15	20 32	78·26
14	21 18	78·26
13	22 4	78·26
12	22 52	75.0

I was sitting in a compartment of an eight-wheeled coach weighing about 19 tons. Notwithstanding the extraordinary speed, the absence of oscillation conclusively testified to both the carriage itself and the permanent way being in a state which it would be unhandsome not to describe as perfection.

The Effect of Freezing upon Impurities Contained in Water.

The extent to which ice is used makes its importance in relation to health almost as great as that of water. An idea prevails that ice cannot be impure, from whatever source it is obtained, as it is supposed to "purify itself" in freezing. About all that is thought of is temperature, and as long as ice is cold little else is considered. Here is an error that has been the cause of much mischief, and as the iced drinks are sipped, their refreshing coolness drives away all thought of possible impurities, just as candies are eaten and the quality, of sweetness is all that is desired or considered. Regarding the effect of freezing upon impurities in water the Massachusetts Board of Health has published experiments, as stated by *Public Health*, with seventy-six samples of water and 336 samples of ice from fifty-eight localities. In ice from polluted sources compared with water from the same, the experiments showed: 1. That in the ice the color and salt had been removed. 2. That all but 13 per cent of the other impurities of the water, as shown by chemical analysis, had been removed. 3. The number of bacteria in the cubic centimeter were: For snow (one sample,) 1,246; for clear ice (part of the same cake as above), 6; for clear ice from an unpolluted source, 0. 4. The average of 12 samples from the most polluted sources, 138. The number of bacteria varied much in different parts of the same cake.

From the examinations which have been made, it appears probable that when ice first forms in the surface of a pond or river, a considerable part of the impurity in the water near the surface is entangled in the first inch or less in depth, and that the ice which forms below this first inch contains but a very small percentage of the impurities of the water. If snow falls upon the thin ice, causing it to sink, so that the water from below saturates the snow, it will freeze without purification; or if rain falls upon the snow and freezes, the ice thus formed contains the impurities of the snow and of the rain water, and of whatever else may have settled out of the air. The method often pursued, of flooding the ice of a pond or river by cutting holes through it, gives a layer of ice as impure as the water of which it is formed.

The purifying effect of freezing is greater upon substances in solution than upon those in suspension. This is confirmed by the fact that a large part of the organic matter, one-half or three-quarters, and sometimes more than is found in good ice, is of particles in suspension, and is readily removed by filter paper.

From the average of all the water and ice used for ice supplies, which they have examined, they find: The organic impurities of snow ice (the sum of the ammonias) =69 per cent of the impurities of the water. The organic impurities of all the ice (except snow ice) =12 per cent of the impurities of the water. The organic impurities of clear ice =6 per cent of the impurities of the water. The color of waters was removed by freezing. The salt of the waters was nearly removed by freezing.

Of bacteria there were: 81 per cent as many in snow ice as in the waters; 10 per cent as many in all other ice as in the waters; 2 per cent as many in clear ice as in the waters.

The results obtained lead to the conclusions: That while clear ice from polluted sources may contain so small a percentage of the impurities of the source that it may not be regarded as injurious to the health, the snow ice, or any other, however clear, which may have been obtained by flooding, is likely to contain so large a percentage of the impurities of the source, and with these impurities some of the disease germs which may be in the source, that the board feels bound to warn the public against using ice for domestic purposes that is obtained from a source polluted by sewage beyond that which would be allowable in a drinking water, stream, or pond, and that in general it is much safer to use for drinking water, and for placing in contact with food, that portion of the ice that is clear.

Rats.

Countless swarms of rats periodically make their appearance in the bush country of the South Island, New Zealand. They invariably come in the spring, and apparently periods of about four years intervene between their visits. In a paper published in the new volume of the Transactions and Proceedings of the New Zealand Institute, Mr. Joseph Rutland brings together some interesting notes on the bush rat (*Mus maorium*). In size and general appearance it differs much from the common brown rat. The average weight of full-grown specimens is about 2 ounces. The fur on the upper portions of the body is dark brown, inclining to black; on the lower portions, white or grayish white. The head is shorter, the snout less sharp, and the countenance less fierce than in the brown species. On the open ground bush rats move comparatively slowly, evidently finding much difficulty in surmounting clods and other impediments; hence they are easily taken and destroyed. In running they do not arch the back as much as the brown rat. This awkwardness on the ground is at once exchanged for extreme activity when they climb trees. These they ascend with the nimbleness of flies, running out to the very extremities of the branches with amazing quickness; hence, when pursued, they invariably make for trees if any are within reach. The instinct which impels them to seek safety by leaving the ground is evidently strong. A rat, on being disturbed by a plow, ran for a while before the moving implement, and then up the horse reins, which were dragging along the ground. Another peculiarity of these animals is that when suddenly startled or pursued they cry out with fear, thus betraying their whereabouts, an indiscretion of which the common rat is never guilty.

Mind and Matter in Science.

In whatever department of thought we find it occupied, the very nature of science is hostile to uncertainty. Facts, indeed, are not its constant possession, but its object, nevertheless, is always to know the truth as true beyond possibility of doubt. Nothing, therefore, can, in strict conformity with its character, be received on mere trust. All that is accepted must be capable of proof, and anything that cannot be thus verified, though true it may be, is to science a thing not known. In reference to all such matters, its position is that of the agnostic, properly so-called, not, that is to say, of a mere creedless bigot, but of an expectant and cautious investigator, accepting in belief only that which he has proved. In virtue of this very position, however, the description here given is but a partial one. It applies rather to a purpose than an actual condition. It is a true portrait of exact science only, and it leaves untouched the illustration of that far-reaching principle by which every branch of knowledge is made subject to the law of development and passes through doubts, conjectures, and shrouded truths to the brightness of clear understanding. Science is no exception to this rule. It has its tentative theories, its mutable facts, and provisional acceptances, and its position would be logically untenable if it were to deny to other modes of thought a share in that charitable consideration which allows time for its own conclusions, however crude, to be planned, marred, recast, and slowly matured. The assumption of such a position would indeed be suicidal, for it implies a fatal schism among the forces concerned in philosophic inquiry.

Science and philosophy, it must be remembered, are not contraries. They are merely the obverse and the converse of the same intellectual process, the former objective, the latter subjective as to its rational method. Either may, in the wider acceptation of its meaning, be taken to include the other, and it is only the prominence of one, the physical application of scientific study, which has associated the former with what we call matter, as distinct from spirit or mind, the natural sphere of the latter. However diverse they may seem to be, distinction between mind and matter is, in the present state of our knowledge, impossible. We are as yet without experience or information respecting the separate condition of one or another. At all points matter is instinct with incorporated properties which constitute the law of its being, though whence derived its atoms cannot tell us; and mind, on the other hand, can only confess itself through its physical manifestations. Though we should penetrate if it were possible beyond the earliest known traces of our world, we might still be as far as ever from a solution of the mystery, but at no stage could we expect to pass beyond the age at which these two became united. Everywhere we still find, whether in vital activity or in the buried vestiges of world-old existence, the sure signs of cause and effect. The design may vary, but its evidences are never wanting.

Some, perhaps, may prefer to regard it as the essential possession of matter, and to dignify this with the attributes of a creator. We cannot but think, however, that the very diversity of material forms, and their infinite variation in conformity with some discoverable purpose in each case, mark them out rather as the vehicles of some compelling force implanted in them. That this force is not purposive but fortuitous in its action is incredible. Given a certain stage in the progress of development, circumstance may, indeed, accomplish many modifications, as the laborious genius of Darwin has abundantly proved; but even these are governed by strict limitations, are apt to be transient in character, and are rather differences of degree than alterations in type. The argument for intelligent design is not seriously impaired, in our opinion, by such evidence of a merely material agency, and there is every reason to believe that this view is yearly gaining ground among the more scrupulous thinkers in physical science. It is significant to find an authority like Professor Tyndall, despite his belief in matter and force as primary factors in the production of life, admitting the probable existence of a "power of creation," which he associates with evolution, and proposes to invest with some feeling akin to worship. Professor Huxley's condemnation of materialism as "the most baseless of dogmas" is also—at least constructively—suggestive of a disposition to include within the beliefs of natural science the existence of a supreme directing intelligence.—*Lancet.*

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — David Altman, Macon, Ga. This invention provides a device whereby an automatic coupling is effected, and an improved mechanism for releasing the link, the coupling pin passing centrally through a lever arranged on top of the drawhead the lever being adapted to be rocked on the drawhead to elevate the pin, and the coupler consisting of few parts, of simple and durable construction

PLATE METAL TIE. — Walter H. Dutton, East Bethany, N. Y. This tie is made of two plates bent near each end to form box-like enlargements supported by plate metal bases, lateral recesses thereon forming rail seats and integral ears on the top edges to receive and retain the rails, with clamping blocks resting on the top edges of the boxes to wedge the rails laterally and hold them to the tie when the blocks are bolted thereto.

Mechanical.

NUT LOCK.—Charles J. Hill, Pavilion, N. Y. This is a nut with radial grooves upon its inner face, to be used with a washer having a groove whose back wall will engage a corresponding groove in the wood or metal to which it is applied, a wire spring projecting from the groove to engage the grooves of the nut and prevent it from turning, the washer also having a suitable catch which may engage the lock spring and prevent it from engaging the nut.

FORGING DIE. — Timothy O'Leary, New York City. This is a die for forming the heads of rock drill pistons and simultaneously shaping the rod, the upper and lower die each having a shaping cavity with beveled sides, the lower die having a vent aperture and a pivoted handle, and the upper die a fixed handle, the metal being formed when placed in the shaping cavities by alternately striking and lifting the upper die and turning the bar.

ENVELOPE MACHINE.—John D. Flammer, New York City. This is a machine to be operated by foot power for automatically and expeditiously folding, pressing and perforating an envelope blank, the machine being of simple and durable construction and one which can be readily transported and conveniently manipulated, and one which can be built at a minimum cost.

FORMING ENVELOPE BLANKS WITH OPENING THREADS.—This is another patent of the same inventor for a machine for securing ribs upon paper, and whereby a thread or a series of threads may be attached to the web as it is delivered from a roll, and the paper at the same time punched or punctured, gummed, and cut to any desired shape.

SOLDERING CAN BODIES. — Mathias Jensen, Astoria, Oregon. This invention covers a method by which the solder is prevented from entering the insides of the bodies during the process of soldering, to prevent spoiling the goods packed and save solder, the ends of the seam of the can body being first bent inward and the seam passed through the flux and solder baths with its bent ends above their level, the bent ends being afterward straightened.

Agricultural.

CULTIVATOR AND SEED DROPPER.—James S. Hickman, Hickman, Ill. This is a combination machine which may be quickly fitted with either cultivating or seeding frames, by lifting either of which by the aid of levers the machine may be conveniently turned at the end of a row, while in the seed-dropping arrangement the drop bar is intended to be sectional and hinged with ball and socket joint.

CULTIVATOR AND SEEDER. — This is another patent of the same inventor for a machine in which a series of cultivators arranged in gangs are employed, and with which the operator can cultivate four, three, or two rows, or one row, as desired, by simply elevating or detaching such cultivators as he may see fit, while shovels, flukes, concave or convex disks, teeth, or horizontal shovel blades, may be employed in connection with the seed-dropping devices for stirring the ground.

THRASHING MACHINE FEEDER.—Cyrille J. Goulette, Ellendale, North Dakota. This invention provides a machine designed to automatically feed the grain and cut the bands, or to feed both bundles and loose grain, and to feed the grain very evenly thus constituting a machine especially desirable in thrashing flax, which is apt to be passed through the machine without being properly thrashed.

Miscellaneous.

MAGAZINE GUN. — Simon B. Shaffer, Ekalaka, Montana. This invention relates to guns wherein a horizontally sliding breech block is operated by a lever that swings downward beneath the frame, with a tubular magazine beneath the barrel, the main objects of the invention being to firmly lock the breech block in position at the time of firing, to obviate the throwing of the breech block to the rear of the hammer when the breech is opened, and to improve the extractor mechanism.

SUBMARINE VESSEL.—Francis W. Pool, Norwich, Conn. This invention is designed to provide means whereby an essentially elliptical hull, having a passenger and an air or gas compartment, may be steered vertically as well as horizontally, and whereby the propeller may be rapidly revolved with a minimum degree of friction through the medium of light and simple machinery.

PADDLE WHEEL. — Maurice Richter, Williamstown, West Va. This invention provides a construction designed for side wheel or stern wheel steamboats, consisting of a wheel having at the edges of its blades nearest the center forwardly projecting extensions of main portions and inclined portions, the latter inclining outwardly from the rear edges of the main portions to the inner edges of the blades, causing the wheel to displace a great deal of water and give great propulsive force for the power used.

LOADER FOR DUMP CARTS. — Gustave Haag, Flushing, N. Y. This is an attachment for any cart to facilitate the loading therein of street sweepings, etc., and consists of an elevator having an endless series of buckets delivering into it, and scooping the dirt directly from the ground, in combination with a stationary curved brush adjacent to and inclosing the rear side of the lower end of the elevator.

WATCH CROWN PIECES. — Allan C. Dalzell, Jr., Sag Harbor, N. Y. This invention relates to the manufacture of watch crown pieces and the crown cores therefor, and the manner of attaching the crown shells to the cores, providing an improved crown piece and a cheap and efficient process of manufacturing the cores and attaching the shells thereto.

PUSH BUTTON.—George H. Streichenberg, Pueblo, Col. This is an attachment for alarm and signaling push buttons, and consists of a suitable clamp on which is pivoted a lever having a flexible connection with the point it is desired to signal from, so that by pulling a cord or wire the push button will be actuated.

NECKTIE. — Philip Hess, New York City. This invention provides a means of changing the worn or soiled upper portion of a necktie having a shield to bring into service the parts that are in an uninjured condition, also affording a pendent scarf portion that is movable and adapted to receive a Teck bow, puffed band, or keeper ring, to hold the scarf longitudinally adjusted.

BRUSH.—Charles D. Hughes, Brooklyn, N. Y. This is a new article of manufacture, the bristles of the brush being formed integral with a block of wood, from which the bristles are cut by suitable machinery, the bristles or splints being cut on the block and arranged in concentric circles.

BASKET CLOSURE. — George Gorton, Racine, Wis. A means for hinging and locking the covers of baskets, hampers, etc., is provided by this invention, and one which will be very neat and durable, and not interfere with the packing of the basket when the cover is detached therefrom, the hinge, locking device and handles being so made that the latter will act with both the former and constitute a portion thereof.

WEATHER STRIP. — John E. Jones, New York City. A strip of spring metal, according to this invention, is bent longitudinally to a U-shaped cross section and applied to the edge of the sash, so that the outer part of the strip will press constantly against the window frame, similar strips being applied at the top and bottom of the sash and at the meeting rails, one of the members of each strip being inserted in a slot formed in the sash.

SCIENTIFIC AMERICAN BUILDING EDITION.

SEPTEMBER NUMBER.—(No. 59.)

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References to former articles or answers should give date of paper and page or number of question.
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Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(2427) G. W. L., A. H., and others.—1. To make printers' rollers, for ordinarily fast presses on book work, the following will be found a good composition: 10½ pounds best glue, 2½ gallons black molasses or honey, 2 ounces Venice turpentine, 12 ounces glycerine. A little larger proportion of glue should be used in summer than in winter. If French glue is used, it should soak overnight to take up the right quantity of water, but most domestic glue will take up sufficient water in about two hours. The turpentine and glycerine should be added and well mixed with the composition just before pouring. 2. The manufacturers of printing inks furnish a prepared drier which will work better than any addition which a printer can ordinarily make, but litharge or boiled linseed oil may sometimes be added to a slow-drying ink, although it is hardly necessary to say that they do not improve the color.

(2428) A. G. asks (1) for the solution of the following problem: A specimen of the U. S. pharmac. hydrochloric acid contains 31·8 per cent by weight of the gas, and its specific gravity is 1·16; what volume of it will be required, theoretically, to mix with black oxide of manganese for the production of one gallon of chlorine water, one fluid ounce of which contains 2·66 grains of chlorine? A. Take 128 fluid ounces to the gallon. Then 128×2·66=340·48 grains of chlorine are wanted. To reduce to grains of hydrochloric acid this must be multiplied by 36·5-35·5, giving 350·07 grains. One fluid ounce standard weight weighs 455·72 grains. Of the given acid (sp. gr. 1·16) a fluid ounce will weigh 528·63 grains and contains 528·63×·318=168·10 grains of hydrochloric acid gas. Therefore the fluid ounces required are 350·07-168·10=2·08 fluid ounces. 2. Please inform me how to remove brown spots on the face resulting from neglected sunburns. The person is afflicted with it since three years, but has done nothing for it yet. The spots are rather different from freckles. His face is covered brown, and his natural skin looks out between the spots. A. We can only recommend an aqueous infusion of the rinds of cashew nuts. The following is a formula for a complete lotion based on the above:

White soft soap	3 oz.
Mucilage, thick	4 "
Best pale honey	4 "

Mix thoroughly in a mortar, add the yolks of 5 eggs previously beaten and strained through gauze, add slowly oil of almonds, scented to taste, 2¼ pounds. When perfectly mixed add cashew nut milk, made by beating up fresh cashew nuts with rose water ¼ pint, and rub until completely mixed.

(2429) C. M. S. writes: 1. Please give me directions how to melt brass so I can mould things and make castings. A. We recommend you the "Brass Founder's Manual," which we can supply for 80 cents by mail. 2. How to make a brown stain for violin. A. The stain for best results should be mixed with the spirit varnish. For reds, dragon's blood or sanders wood; for yellows, aloes, annatto, gamboge, turmeric or saffron is used. Mix to suit taste. The following is a simple spirit varnish: Mastic 1 drachm, sandarac 1 drachm, lac 6½ drachms, alcohol 5 fluid ounces. If you desire, you may stain the wood with an alcoholic infusion of any of the above colors, shaking them frequently in alcohol and pouring off the clear solution after twenty-four hours. 3. How to ebonize pine wood or any other wood. A. Boil 40 parts gall nuts, 4 parts rasped logwood, and 5 parts each sulphate of iron and verdigris with water, strain and apply warm. Then give it three coats of acetate of iron, which may be made by dissolving 10 parts of iron filings in 75 parts strong vinegar. Pine will not give good results. Cherry, pear, or walnut should be used. 4. What books to read to study electricity. A. There are a number of excellent works. We mention more particularly "Practical Electricity," by W. E. Ayrton, price $2.50, also "Electricity in the Service of Man," price $6.

(2430) H. L. H. writes: I want to make good glossy red paint to dry quick. How can I get it? I have been using Chinese vermilion and gum arabic water. A. Dissolve the best red sealing wax in strong alcohol. Or simply make a strong solution of shellac in alcohol and stir in enough of Chinese vermilion to give a good color and body.

(2431) F. & T. Manufacturing Co. write: We have been using benzine as a cleaner by having a dish of it large enough to dip a machine in, but owing to the danger from explosion and fire we are very desirous of using something else, and would like to know if you know of anything to take its place. A. We cannot suggest any substitute. Strong ammonia is recommended as an extinguisher of oil fires, and might be kept on hand in glass-stoppered bottles to be used as fire grenades in case of trouble.

(2432) A. B. S. writes: Will you advise me if there are any two or three kinds of metal that when brought in contact will form an electric circuit? And if there is, please state what they are. A. Theoretically, any dissimilar metals will do this if we adopt the contact theory of electricity. Practically, they will not, as the discharge is not perceptible externally.

(2433) J. D. asks how xanthate of potash is made. A. Alcohol of 0·800 sp. gr. is saturated while boiling with caustic potash. Into this carbon disulphide is dropped until it ceases to dissolve or until the liquid is no longer alkaline. On cooling to 40° Fah., the potassium xanthate separates as crystals. These are pressed between blotting paper and dried in a vacuum. Exposure to the air spoils them. The salt may be dissolved in water or alcohol. The proportions for preserving food must be ascertained by experiment. Probably 1 part in 10,000 would have some effect.

(2434) A. S. asks: 1. What is put in beer to make it ferment? A. Yeast. 2. How brewer's yeast is made. A. The following is a good formula: Ground malt 2 pounds, hops 2 ounces, add 1 gallon water at 170° Fah. Soak for six hours, strain, and add two or three boiled potatoes mashed up. Then put in two or three dry yeast cakes crumbled fine, having liquid milk warm, keep warm until the liquid ferments. If a little meal is mixed in warm water, it will ferment in time and be the basis for starting a yeast mixture.

(2435) F. S. M. asks: 1. Is it possible to photograph distant objects by combining camera and telescope? If so, how should the two be arranged? A. Yes. We refer you to our SUPPLEMENT, No. 225. 2. What is the best way to keep glass jars from breaking when filling with hot preserves? A. Bring the jars gradually to the heat of the preserves by immersing them in cold water and heating it.

TO INVENTORS.

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AND EACH BEARING THAT DATE.

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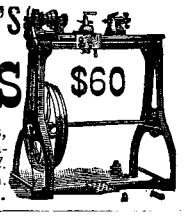

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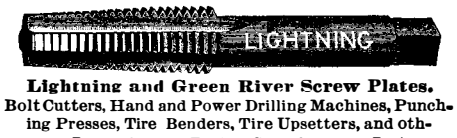

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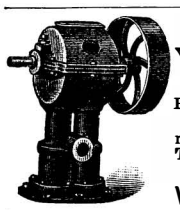

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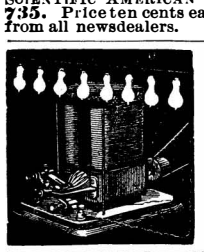

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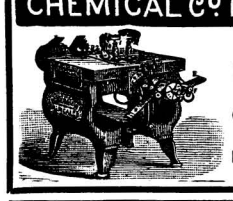

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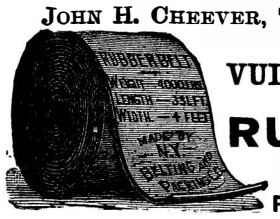

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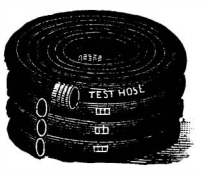

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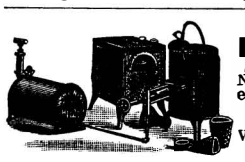

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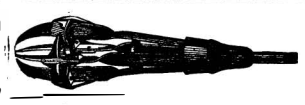

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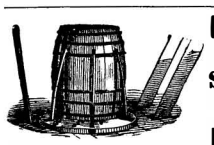

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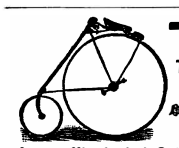

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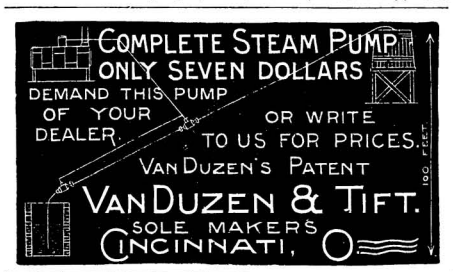

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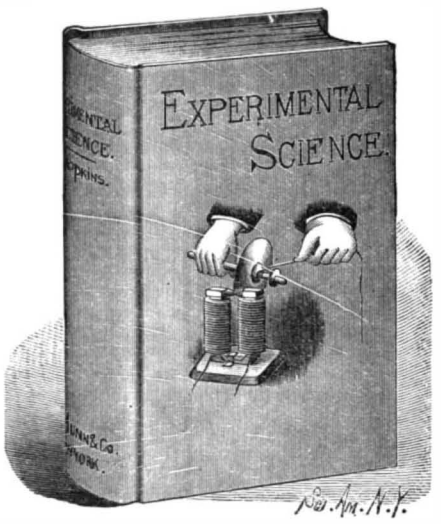

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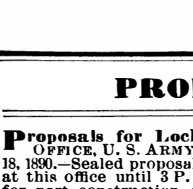

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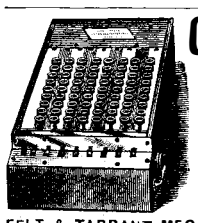

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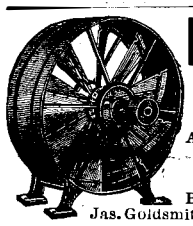

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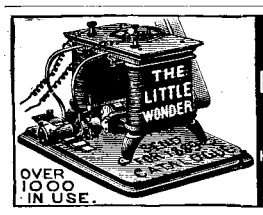

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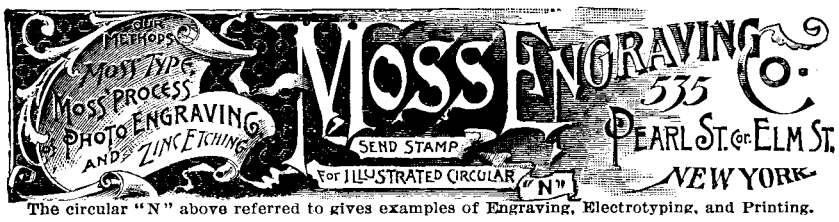

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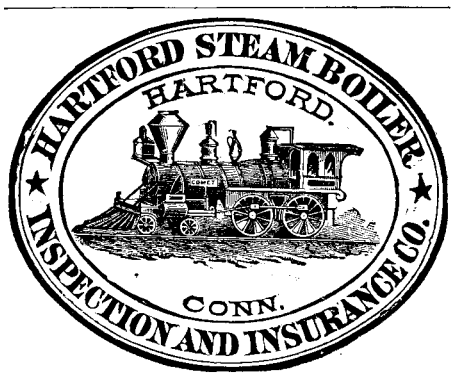

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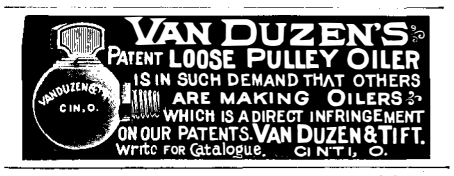
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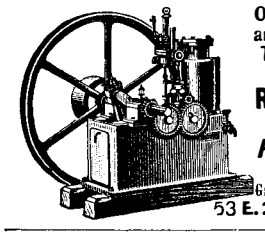

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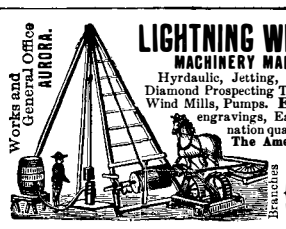

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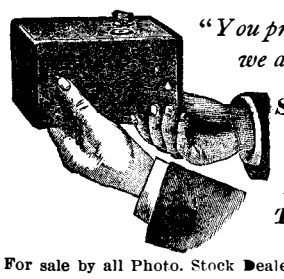

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